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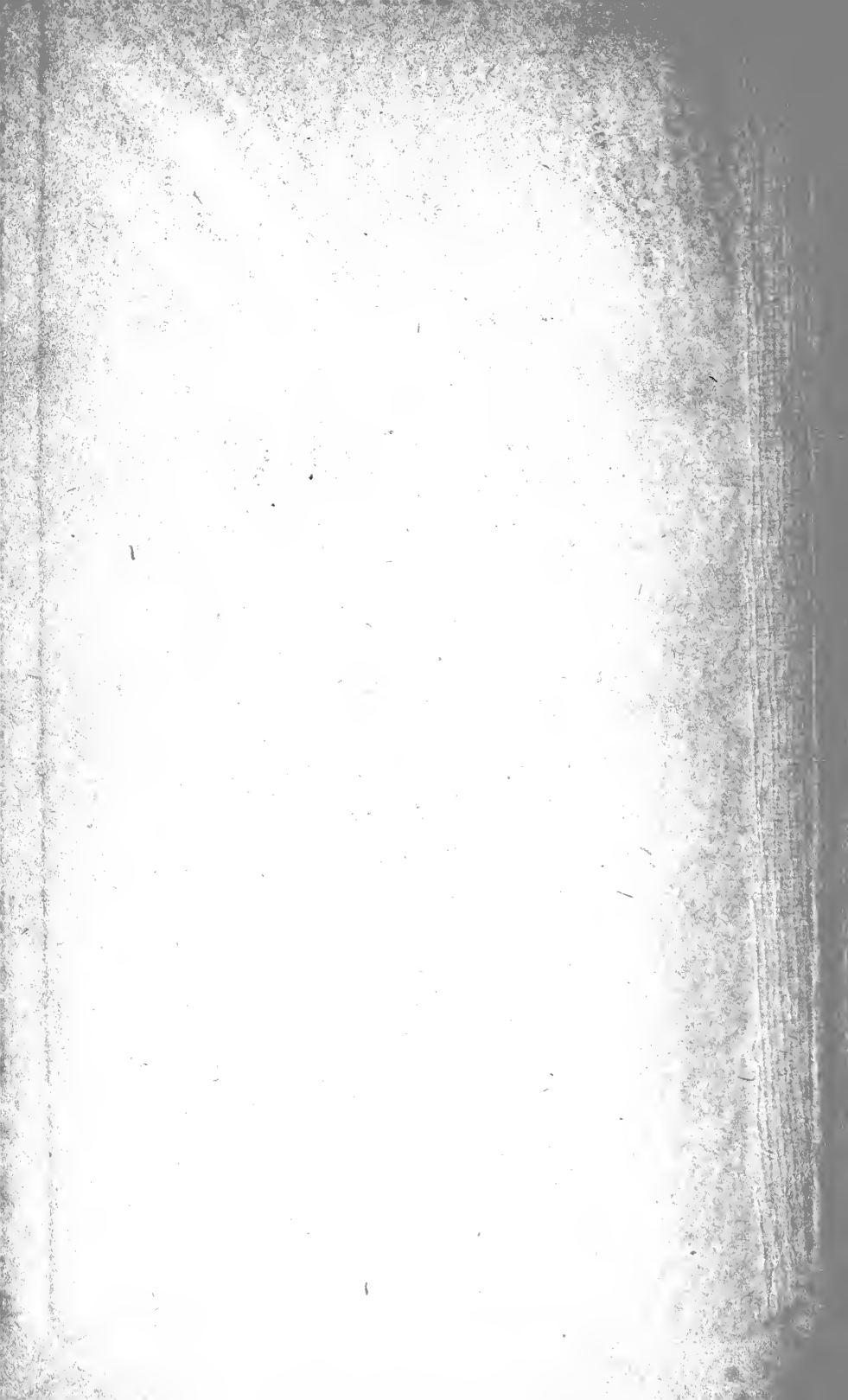
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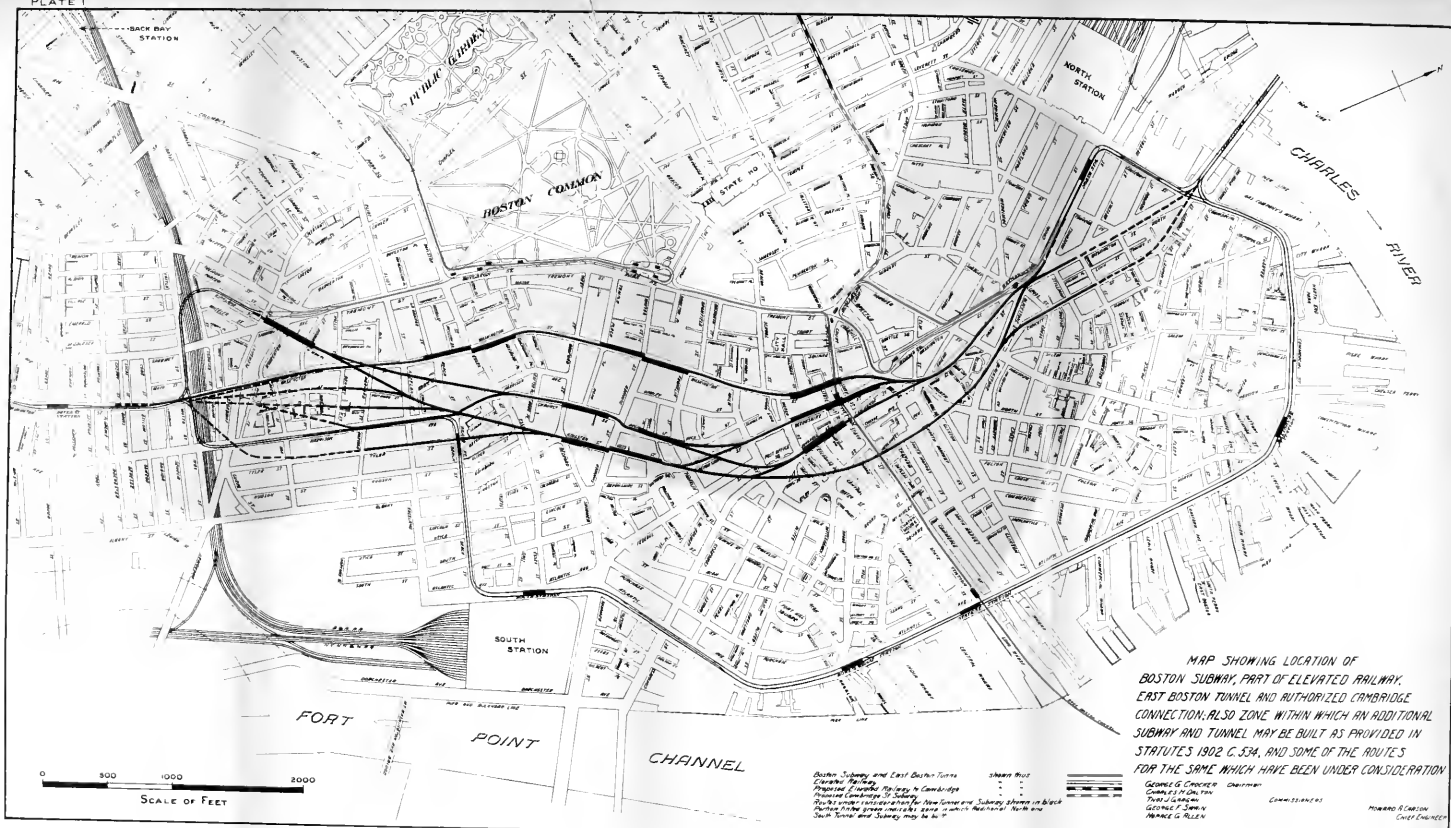
Boston Transit Commission.

Ninth Annual Report.



June 30, 1903.





MAP SHOWING LOCATION OF
 BOSTON SUBWAY, PART OF ELEVATED RAILWAY,
 EAST BOSTON TUNNEL AND AUTHORIZED CAMBRIDGE
 CONNECTION; ALSO ZONE WITHIN WHICH AN ADDITIONAL
 SUBWAY AND TUNNEL MAY BE BUILT AS PROVIDED IN
 STATUTES 1902 C. 534, AND SOME OF THE ROUTES
 FOR THE SAME WHICH HAVE BEEN UNDER CONSIDERATION

NINTH ANNUAL REPORT

OF THE

BOSTON TRANSIT COMMISSION,

FOR THE YEAR ENDING

JUNE 30, .1903.



BOSTON

ROCKWELL AND CHURCHILL PRESS.

1903

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BOSTON TRANSIT COMMISSION.

20 BEACON STREET, BOSTON, June 30, 1903.

TO THE CITY COUNCIL OF THE CITY OF BOSTON :

In compliance with Statutes of 1894, chapter 548, section 24, the report of the Boston Transit Commission for the year ending June 30, 1903, is respectfully submitted.

REORGANIZATION OF THE COMMISSION.

By chapter 534 of the acts of the year 1902, which act was accepted by a majority of those voting thereon at the municipal election in Boston held on Dec. 9, 1902, the term of the Commission was extended to the first day of July, 1906. It was further provided that appointments of the members of the Commission should be made by His Excellency the Governor and by His Honor the Mayor of the City as heretofore for terms of two years.

The Governor reappointed George G. Crocker and Horace G. Allen, and the Mayor reappointed Charles H. Dalton, Thomas J. Gargan and George F. Swain. These appointments having been confirmed by the Executive Council and the Board of Aldermen respectively, the Commission, at its first meeting, held on July 10, 1902, effected an organization by the re-election of George G. Crocker as Chairman, and B. Leighton Beal as Secretary. Howard A. Carson was reappointed as Chief Engineer.

EAST BOSTON TUNNEL.

The Scollay Square Terminal.

On Aug. 26, 1902, the following votes were passed :

Voted, That the Commission deems that the public interests require that the East Boston tunnel be connected with the existing subway at Scollay square by means of staircases, elevators or otherwise, the said tunnel being carried under the existing subway at said square and being so placed and constructed that later it can be connected with the Cambridge-street subway when said subway is built.

Voted, That the consent of the Boston Elevated Railway Company be asked to making connection as indicated in the preceding vote.

This action was taken under the provisions of chapter 114 of the acts of the year 1902. The Boston Elevated Railway Company, on Aug. 26, 1902, was notified of the passage of the above votes, and its consent asked.

At a conference with officials of the company, held Dec. 18, 1902, the President stated that the company had delayed consideration of the advisability of a sub-station connection at Scollay square until the act providing for the construction of an additional north and south tunnel and subway should be accepted or rejected by the voters of the city, and that the act having been accepted, the company desired time to study the question as a part of the whole transportation problem.

This attitude of the company was formally set forth in the following communication :

PRESIDENT'S OFFICE,
101 MILK STREET, BOSTON, MASS., January 1, 1903.

BOSTON TRANSIT COMMISSION, 20 Beacon Street, Boston, Mass.

DEAR SIR: Referring to the suggestion that a decision should be reached as to the proposed new SubSubway Station at Scollay Square for East Boston Tunnel traffic, we desire to say that we feel that this is a matter to be considered, not separately, or even as a station for the joint use of that tunnel and of the proposed new subway in connection with the Elevated to Cambridge, but in connection, also, with the building of the new Washington Street Tunnel and Subway.

The East Boston business might, perhaps, temporarily be handled from the State Street Station.

We feel very strongly that up to this point the necessities of the situation have compelled the consideration of the transit question of this community to be taken up piece-meal, and that while the steps already taken in connection with the surface lines, with subways and with the Elevated, must be dealt with as they now exist, the relations of the East Boston Tunnel, the new Cambridge line, the new Washington Street Subway and Tunnel, both to each other and to the existing lines of traffic, can and ought to be handled, as far as possible, in a comprehensive way, and as parts of one problem.

We realize, of course, that we are suggesting nothing new to you in this statement of the situation, which we have made thus fully, only to explain our own position in delaying to act upon your request for our consent to your plans for a sub-subway station at Scollay Square.

We shall esteem it a favor if at the earliest possible moment you will allow this Company to confer with your Honorable Commission with respect to plans for the Washington Street Tunnel and Subway and connections, especially those parts in the vicinity of the proposed Scollay Square Station.

Respectfully yours,

BOSTON ELEVATED RAILWAY COMPANY,

(Signed)

By WM. A. BANCROFT, *President*.

To this the Commission made the following reply :

BOSTON, January 8th, 1903.

WILLIAM A. BANCROFT, *President*, Boston Elevated Railway Co.

DEAR SIR: In reply to your letter of the 1st inst. The handling of the East Boston tunnel business at the Old State House station,

even temporarily, as you suggest, could only be justified by its being absolutely necessary.

The Commission thinks there is no such necessity.

The connection between the East Boston tunnel and the Cambridge st. subway by a sub-station at Scollay square presents no grave difficulties in design, but a connection of these two lines at grade with any new Washington street (so-called) subway or tunnel seems to us, in a business sense, impracticable. While, perhaps, not an engineering impossibility, its complication and cost would not justify its serious consideration, and the Commission has not attempted to devise any such scheme. If, however, your engineers have done so, the Commission will give your plans and suggestions immediate and careful attention.

The Commission believes that the Washington street routes are not involved in the treatment of the Scollay square sub-station and that the connections by stairways between the new north and south subway and tunnel and the East Boston tunnel would naturally be at or near the Old State House station. Some studies have been made accordingly which promise to be practicable in construction and convenient for the public.

Work on the side walls of the East Boston tunnel is already started in Court street on lines approved by you. The building of a sub-station at Scollay square, under the present station, will be a work requiring unusual care in order to avoid injury to the present structure or interference with its uses, and cannot be hurried. * Possibly it can be completed by the time the rest of the tunnel is ready for use, but to do so there should not be any further delay in deciding upon the plans and beginning work.

The Commission laid plans for the Scollay square sub-station before you in August last. On the return of Messrs. Sergeant and Kimball from Europe subsequently, these plans were discussed by them and the engineer of the Commission, alterations made to meet their views and a general agreement was arrived at as to arrangement of platforms, tracks, exits, entrances, etc. Since then, this Commission has been awaiting your formal consent to such connection by means of a sub-station instead of at grade. The Commission is anxious to receive such formal consent at your earliest convenience.

So far as concerns the selection of a route or routes for the new north and south subway and tunnel lately authorized several studies beside those shown to you in November have been made and much additional information as to the estimated cost has been gathered.

Upon these matters the Commission is desirous of a conference with you and your officials at your earliest convenience and proposes Tuesday next, (Jan. 13) at 11 A.M.

BOSTON TRANSIT COMMISSION,
By GEORGE G. CROCKER,
Chairman.

(Signed)

On Feb. 7, 1903, the company gave its consent in the following terms :

PRESIDENT'S OFFICE,
101 MILK STREET, BOSTON, MASS., Feb. 7th, 1903.

BOSTON TRANSIT COMMISSION, HON. GEORGE G. CROCKER, *Chairman*,
20 Beacon Street, Boston, Mass. :

DEAR SIR: Referring to your letter of January 8th and to several interviews had between the Chairman of your Honorable Board and Mr. Winsor, and also between the Chairman and myself, I am authorized to say that this company is unable to conclude that there is any necessity

for the immediate construction of a sub-subway station at Scollay square. We understand that there need be no delay in the operation of the East Boston tunnel because of the feasibility of using the station at the Old State House as a terminus. On the other hand, the company believes that the studies which are now being made to determine the route of the Washington street subway, so-called, and its relation to other subways and to the local transportation system in general may make some plan other than the proposed one expedient.

But in view of the evident desire of the Transit Commission that this company should give its consent to the plan for a sub-subway station at Scollay square, which has been considered by the Engineer of the Transit Commission and also by the officials of this company, and which may be referred to as the plan sent to your Mr. Carson and by our Mr. Kimball on November 4th last, entitled "Scollay Square Study for Station on Cambridge and East Boston Tunnel" dated Nov. 3rd, 1902, — the company hereby gives its consent to the connection of the East Boston tunnel with the existing subway at Scollay square by means of a sub-station, in accordance with said plan, instead of at grade.

The plan above referred to shows only the general scheme of the station. We should very much like to be consulted later in regard to some of the details which are not fully shown on said plan.

We hope we have made it clear that, while we have given our consent at your request for the reason stated, we doubt the expediency of constructing such a sub-station and making such connection at this time.

Respectfully,

(Signed)

WM. A. BANCROFT,

President.

On Feb. 12, 1903, the Chief Engineer was instructed to proceed with plans and specifications for completing the East Boston tunnel to a connection with the present subway at Scollay square, by means of a sub-station in accordance with the plan of Nov. 3.

At a conference with officials of the company, held on April 16, it was stated by them that they had determined to adopt a train service on the Cambridge elevated and subway line, and a single car service in the East Boston tunnel, and that a through connection between the East Boston tunnel and the Cambridge street subway would therefore be useless. They further suggested that when the elevated trains are removed from the existing subway, allowing it to be used exclusively for surface cars, it would be a convenience to the public to connect the tunnel tracks with the subway at grade, thus allowing through cars to run from Roxbury and the western suburbs to East Boston. They submitted a plan making such connection at Scollay square, thereby establishing a grade crossing of the northbound subway track by the west and southbound tunnel track. The policy of the Commission hitherto has been to avoid grade crossings in the subway, such crossings being a constant source of danger and delay on surface tracks, where they are nevertheless unavoidable. In spite of these

evident objections, the Commission recognized that the decision not to run the Cambridge elevated trains through the tunnel to East Boston was a sufficiently controlling reason to make the change proposed by the company. Furthermore the convenience of a large proportion of passengers from Cambridge and East Boston arriving at Scollay square would be greatly increased by having the platforms near the surface of the streets instead of in a sub-station, requiring the use of elevators. The change being also in the direction of economy, the Commission, on May 19, adopted a plan substantially in accordance with that suggested by the company. These grade connections cannot, however, be used until the elevated trains are removed from the present subway and the tracks restored to the use of surface cars. Until that time the East Boston tunnel will be operated separately.

Proposals for constructing that part of the tunnel from the Old State House to a connection with the present subway have been advertised for, to be opened on Tuesday, July 7.

The Taking of the Easement under Long Wharf.

Early in the present year, the work of construction having reached the west side of the harbor, it became necessary to take by eminent domain the right to pass under Long wharf. The law allows the taking of an easement to be confined to a portion or section of a parcel of real estate fixed by horizontal planes of division below or above or at the surface of the soil. This power was exercised. The top of the tunnel at the easterly end of Long wharf is 59 feet and at the westerly end is 38 feet below the surface. Between these points the tunnel runs on a 2.5 per cent. grade, and for the greater part of the distance on a curve. The instrument of taking described two curved vertical planes and four horizontal planes of division. It is recorded in the Suffolk Registry (Lib. 2874, Fol. 212) and is believed to be unique. A copy will be found in Appendix A.

Appropriations.

The amount placed at the disposal of the Commission by the subway act of 1894 was \$7,000,000. When the construction of the East Boston tunnel was authorized, an additional appropriation of \$500,000 was made. The subway has cost in round numbers \$4,165,000. This amount deducted from \$7,500,000 leaves a balance of \$3,335,000, a

sum amply sufficient to complete the East Boston tunnel. By chapter 347 of the acts of the year 1897 provision was made for transferring to the city for a market or other public purposes, at a valuation approved by the mayor, a considerable portion of the land between Canal and Haverhill streets acquired from the Boston & Maine Railroad, which land was then no longer needed for subway uses. This land was valued at \$616,000. Upon its transfer the cost of the subway was reduced by that amount to the sum above named, but the act provided that the \$7,000,000 appropriation should be reduced by a like amount. Deducting \$616,000 from the amount otherwise available, namely, \$3,335,000, left \$2,719,000 available for building the East Boston tunnel.

Early in the session of the Legislature for the present year the following communication was submitted to His Excellency the Governor :

BOSTON, January 30th, 1903.

To His Excellency the Governor JOHN L. BATES :

DEAR SIR: Respectfully represents the Boston Transit Commission

That by chapter 500 of the acts of the year 1897, it was ordered to construct a tunnel or tunnels from a point on or near Hanover street in the city of Boston or such other point or points as said Commission may deem proper for a suitable connection with the subway or subways provided for in § 25 of chapter 548 of the acts of the year 1894, to a point at or near Maverick square in that part of Boston called East Boston, where a suitable connection with surface tracks may be made ;

That under date of January 27, 1898, the Commission submitted to the General Court a communication in which it was stated that the preliminary estimates of the cost of building such tunnel or tunnels from East Boston to an actual connection with the then existing subway varied, according to the route which might be selected, from three and three-quarters millions of dollars to over four millions of dollars, and that the authorized expenditure was insufficient therefor ;

That in the following year, 1899, the Supreme Judicial Court determined that the act, notwithstanding the insufficiency of the fund placed at the disposal of the Commission, required such tunnel or tunnels to be built so as to make such actual physical connection with the then existing subway ;

That the sum available for building the tunnel is in round numbers \$2,719,000 ;

That the Commission by substituting in that portion of the tunnel under the harbor concrete in place of cast-iron, which had hitherto been used elsewhere for such purposes and which was contemplated in the estimates referred to, is constructing the said tunnel for less than the original estimate so that it now appears that the sum of three hundred thousand dollars in addition to the expenditure heretofore authorized will be sufficient ;

That provision for such additional expenditure of three hundred thousand dollars should be made at the present session of the Legislature ;

That the above estimate does not cover any payment to individual owners, if any, of the fee of land within the street lines, for the tunnel easement thereunder, the Commission being advised that such claims cannot be sustained ;

Wherefore, said Boston Transit Commission makes report as above to the end that such action may be taken in the premises as to Your Excellency may seem fitting.

(Signed)

BOSTON TRANSIT COMMISSION,
By GEORGE G. CROCKER,
Chairman.

This was transmitted by the Governor to the Legislature, which, after a hearing before the Committee on Metropolitan Affairs, passed a bill (chapter 190, acts 1903) authorizing an additional expenditure of \$300,000. This act will be found in Appendix B.

Areas in State and Court Streets.

In constructing the tunnel under State and Court streets, and making the requisite relocations of pipes, sewers and conduits, it has been and will be necessary to make use of a portion of certain areas under the sidewalks. The following communications relate thereto :

BOSTON, MASS., Sept. 11, 1902.

HON. GEORGE G. CROCKER, *Chairman, Transit Commission, 20 Beacon Street, Boston, Mass. :*

MY DEAR SIR: I write you in behalf of the Massachusetts Hospital Life Insurance Company, as you know, the owner of a building and real estate on State Street, to ask what it is the intention of the Commission to do in the street where the Company's property abuts upon it. The Life Company owns the fee to the middle of the highway and is in occupation and enjoyment of a considerable portion of it beneath the surface of the street which will be interfered with by the construction of a subway. As I understand it, no location has been filed by the Commission, taking any of the land of the Company. May I ask when the Commission intends to file such a location ?

I also desire to add that the Hospital Life Insurance Company requests you to file such location at as early a date as is convenient, in order that its rights may be properly protected.

Yours very truly,

(Signed)

CHARLES F. CHOATE, JR.

BOSTON, September 17, 1902.

HON. GEORGE G. CROCKER, *Chairman, 20 Beacon Street, Boston :*

DEAR SIR: We write in behalf of Mr. J. M. Sears, the owner of Sears Building at the corner of Court and Washington Streets in the City of Boston. Mr. Sears owns the fee of Court and Washington Streets opposite his building to the middle of the streets, and occupies and uses a considerable part of the space beneath the surface of the streets.

From the plan filed by the Transit Commission in the office of the City Surveyor, we learn that it is the purpose of the Transit Commission to construct the tunnel to East Boston beneath the surface of Court Street and Washington Street, so that the tunnel will occupy land of which Mr. Sears owns the fee, and will interfere with his use and occupation of the space beneath the surface of the streets. We understand that no location has yet been filed by the Commission taking any part

of the estate of Mr. Sears, and have been informed that it is the intention of the Commission to construct the tunnel in Court Street and Washington Street without taking by right of eminent domain any of the lands, easements, estate or rights therein.

We wish to ask, first, whether such is the intention of the Commission; and, second, to request that if the Commission intends to take by right of eminent domain any part of Mr. Sears' estate, including any part of Court Street or Washington Street, of which he owns the fee, that the Commission will file such taking in the Registry of Deeds as soon as convenient.

Yours very truly,

(Signed)

HUTCHINS & WHEELER.

The Commission has been advised by the Law Department of the city that the claims made in the foregoing communications cannot be sustained, and that a taking by right of eminent domain is unnecessary. Proceedings to test this question have been begun in the Supreme Judicial Court by Mr. J. M. Sears.

Footway in Maverick Square.

On Jan. 15, 1903, the Common Council, through His Honor the Mayor, requested the Commission to substitute for the wooden foot-bridge over the mound of the subway entrance in Maverick square, East Boston, a permanent metal structure, to which request the Commission replied as follows:

BOSTON, January 20, 1903.

To His Honor the Mayor PATRICK A. COLLINS:

DEAR SIR: Your communication under date of Jan. 15, 1903, transmitting an order passed by the Common Council that the Transit Commission be requested to substitute for the wooden foot bridge over the mound of the subway entrance at Maverick square a permanent metal structure, has been received.

At a meeting of the Commission held this day the Chief Engineer was instructed to cause such foot bridge or footway to be constructed of metal and concrete according to plans heretofore adopted by the Commission so soon as the spring is so far advanced that the concrete can be properly laid.

BOSTON TRANSIT COMMISSION,

(Signed)

By GEORGE G. CROCKER,

Chairman.

The contract for the same was awarded April 29, and the work is nearly completed.

NEW TUNNEL AND SUBWAY.

Chapter 534 of the acts of 1902 provided for the construction of a tunnel especially adapted for elevated train service and a subway especially adapted for surface car

service. The Commission was required within ninety days after the passage of the act to execute with the Boston Elevated Railway Company, in the name of the city, the company consenting thereto, "a contract in writing for the sole and exclusive use of the tunnel and subway and appurtenances for the period of twenty-five years from the beginning of the use of the tunnel, at an annual rental equal to four and one-half per cent of the net cost of the tunnel and subway, respectively," and "for such other uses and upon such provisions and conditions, not affecting the term or rental, as the commission and the company may agree upon, or in case of difference, as the board (of Railroad Commissioners) may determine." The act having been approved by the governor, June 27, 1902, ninety days therefrom brought the limit of time for the making of the contract to Sept. 25, 1902. The first work of the Commission, therefore, under the new act was the preparation of this contract. A draft was made, based upon the contract for the use of the subway, and was submitted to the Boston Elevated Railway Company July 22. Early in September notice was informally received from the company of a desire for material modification of the draft thus submitted, in consequence of which a large part of the sessions of the Commission of Sept. 9, 11, 12, 16, 17 and 18 was devoted to the proposed modification. On the last-named date a contract was executed by the Commission in the name and behalf of the city, and a copy delivered to the Boston Elevated Railway Company. On Sept. 23 the company submitted to the Commission its draft which did not meet with the approval of the Commission. On that day a conference was held with representatives of the company, at which the points of difference were discussed. These related principally to "Abatement of Rental," "Repairs," "Liability for Damages," and "Default and Penalty." An agreement was not reached. The company thereupon, under section 10 of the act, requested the Board of Railroad Commissioners to determine the provisions in controversy. On Thursday, Sept. 25, notice was received from that board that it had determined upon a contract in the form as shown in Appendix C. The contract as determined upon by the board was thereupon executed by the Commission and the company.

The construction of the new tunnel and subway was dependent upon the acceptance of the act by the voters of the city of Boston at the municipal election; but the Commission was authorized, without waiting for such acceptance,

to make preliminary investigations, plans and surveys, and to do all things necessary therefor. This work was begun soon after the passage of the act.

The act having been accepted by the people at the municipal election, the Commission, on Dec. 11, passed the following vote :

Voted. That in the matter of the proposed tunnel and subway authorized by statutes 1902, chapter 534, which act was accepted by the voters of the city on December 9th inst. the Chief Engineer be instructed to proceed with all reasonable expedition to make additional borings, to revise the studies of routes and the estimates and plans heretofore submitted, with such additions as have been suggested so that the routes of such tunnel and subway may be definitely determined and the work of construction begun at as early a date as possible.

At each meeting of the Commission subsequent to that date the district within which the structures might be built was studied for feasible routes, until more than a score were under consideration. The examination and comparison of these with regard to cost, alignment, feasibility and accommodation of the public resulted in the elimination of all except about half a dozen. On Jan. 13, 1903, the first of a series of conferences was held with the Executive Committee and the Chief Engineer of the Boston Elevated Railway Company, to whom these studies for routes were shown and approximate estimates of cost given. These conferences were continued on Feb. 10, 17, 18, 19, March 3, 10, 17, 26, April 16, 29, May 5, 12, 15, 22, June 5 and 19.

On Feb. 28 the following communication was sent to the Boston Elevated Railway Company :

BOSTON, February 28th, 1903.

BOSTON ELEVATED RAILWAY COMPANY, WILLIAM A. BANCROFT,
President:

DEAR SIR: This Commission has been for some time studying the problem whether it is expedient under chapter 534 of the acts of the year 1902 to begin at once the construction of a structure or structures for four tracks as permitted by the last sentence of the first section of said act, provided the company by its Board of Directors consents thereto.

Before deciding this question the Commission would like to receive from your Board of Directors such statistics of present traffic and estimates of future traffic as may have a bearing upon the matter, together with a statement of such other considerations as may seem to them important.

BOSTON TRANSIT COMMISSION,

(Signed)

By GEORGE G. CROCKER,
Chairman.

The company replied as follows under date of March 30, 1903 :

PRESIDENT'S OFFICE,
101 MILK STREET, BOSTON, MASS., March 30, 1903.

BOSTON TRANSIT COMMISSION, GEORGE G. CROCKER, *Chairman*, 20
Beacon Street, Boston, Mass. :

DEAR SIRS: We beg to acknowledge the receipt of your favor of February 28th.

If it were deemed advisable to have, when built, both a tunnel for the Elevated trains, and a subway for the surface cars under Washington Street, then it would probably be necessary, or at least, desirable, to build both at this time. We do not understand that this is deemed advisable, but, on the contrary, that various reasons make it desirable that when both a tunnel and a subway shall have been built, the tunnel shall be to the east of Washington Street; some of the reasons being : —

1. That Washington Street is already congested by foot passengers and the giving of additional facilities under that street would but add to that congestion.

2. That the large office district is growing very rapidly, and likely in future to grow more rapidly, and that traffic would not only be removed from Washington Street by a tunnel to the east of Washington Street, but would be more conveniently served thereby.

Under the provisions of the Acts of 1902, chapter 534, if but two tracks are to be built at once, they must be in the tunnel, so-called. If this tunnel is to be to the east of Washington Street, we believe that it would not be expedient to build the subway until after its completion, as we estimate that such a tunnel would add at least 75% to the north and south subway carrying capacity of the City, which would take care of the present congestion and the natural increase for at least several years, and to such an extent as to give time after it had been in operation, to form a clearer judgment than can now be formed, as to the building of the subway.

We are, therefore, for these reasons of the opinion that it is expedient at this time to build only the tunnel, but we feel that we should say to you also that the rental burden involved by the building of both the tunnel and subway at this time, would be so heavy as in itself to make it impossible for us to assent to the building of the subway at this time.

Yours very truly,

BOSTON ELEVATED RAILWAY COMPANY,

(Signed)

By WM. A. BANCROFT,

President.

The last sentence of the first section of chapter 534 above referred to reads : "The structure or structures for all four tracks, with the appurtenances, or any part or parts thereof, may be begun at any time after the acceptance of this act by a majority of the voters of the city as hereinafter provided, if and so far as the commission deems it expedient and if the company by its board of directors consents thereto." The company, by its board of directors, having signified its unwillingness to give the necessary consent, the Commission abandoned the idea of building the structures for all four tracks at the same time.

Early in May the company changed its views in relation to the location for the tunnel and urged the adoption of a route under Washington street and the use, from Adams square, north, of two tracks of the present subway, at the same time expressing the desire that the Commission apply to the Legislature for an enabling act, since the act of 1902 provided that "upon the completion of the tunnel and appurtenances and upon notification as hereinbefore provided, the company shall remove its elevated trains and cars from the existing subway." May 5 the Commission, by vote, expressed its unwillingness to consider further any such plan, unless in substitution for the tracks so used provision should be made for new tracks furnishing equivalent accommodations for traffic. * On May 29 the following votes were passed:

Voted, That, in the opinion of this Commission, it is inexpedient to build a tunnel in Washington street, south of Adams square, for elevated trains.

Voted, That it is inexpedient to ask for additional legislation at the present session of the Legislature.

This action led to the following correspondence:

PRESIDENT'S OFFICE,

101 MILK STREET, BOSTON, MASS., June 8, 1903.

To the Honorable Boston Transit Commission, 20 Beacon Street, Boston, Mass.:

DEAR SIRS: Referring to your communication of May 26th ult., as follows:

MAY 26th, 1903.

WILLIAM A. BANCROFT, *President, Boston Elevated Ry. Co.:*

DEAR SIR: The expediency of asking the *Legislature* for a further enabling act was discussed at length at the meeting of the Commission this morning, but no action was taken.

Yours very truly,

(Signed)

GEORGE G. CROCKER

Chairman.

and also to your communication of May 29th ult., as follows:

May 29, 1903.

WILLIAM A. BANCROFT, *President, Boston Elevated Railway Co.:*

DEAR SIR: The following were passed at a meeting of this Commission held to-day:

"*Voted*, That, in the opinion of this Commission, it is inexpedient to build a tunnel in *Washington street*, south of Adams square, for elevated trains.

"*Voted*, That it is inexpedient to ask for additional legislation at the present session of the Legislature."

A true copy.

Attest:

(Signed)

B. LEIGHTON BEAL,

Secretary.

and to the informal interview, which Mr. Winsor had with your Board last week; we beg to say that it seems to us desirable, even in the event of its being necessary to eliminate the Washington street route from consideration, to have the technicality in the Bill of 1902 removed so as to permit your Board to use, if desirable, two tracks of the existing subway north of Adams square for elevated trains, on condition of the replacement for the use of surface cars of the two tracks so taken.

As we have frankly stated to you, it now seems to us that no route for elevated trains east of Washington street will be on the whole as desirable as the Washington street route. This opinion is formed only after months of study looking to a route east of Washington street, and is diametrically opposed to the views which we held two or three months ago. This opinion might compel us to appeal from your decision to the Board of Railroad Commissioners. The desire of both your own body and ourselves is, of course, to have selected ultimately the route which shall be most desirable from the point of view of the public convenience.

If the Board of Railroad Commissioners, on appeal, should decide in favor of the Washington street route, it would, of course, be important that the technicality of the Act of 1902 should have been removed, so as to enable the running of trains north of Adams square through Washington street.

We should, therefore, be glad if your Board could see its way clear, to changing its decision in regard to the inexpediency of asking the Governor to apply for this change in legislation at the present session.

We may add that no decision has been reached by us as to the advisability of appeal to the Board.

Very respectfully,

(Signed)

WM. A. BANCROFT,

President.

BOSTON, June 12, 1903.

WILLIAM A. BANCROFT, *President, Boston Elevated Railway Company:*

DEAR SIR: Your letter of June 8th was duly received and its suggestions have been considered by this Commission.

You write that it seems to your Board of Directors desirable "to have the technicality in the bill of 1902 removed so as to permit the Commission to use, if desirable, two tracks of the existing subway north of Adams sq. for elevated trains on condition of the replacement for the use of surface cars of the two tracks so taken."

You further state that your Company favors the Washington street route for the tunnel for elevated train service, and you express the wish that this Commission might see its way clear to asking the Governor at the present session of the Legislature to apply for an amendment of the act granting the desired permission.

The Commission on the other hand deems that a route east of Washington street should be selected. In connection with such route the Commission may deem it expedient, though it will not be necessary, to use for the elevated train service between Haymarket square and Causeway street, two of the tracks now used for the northern approach to the subway and substitute therefor equivalent tracks on the Canal street side.

If this course should be deemed desirable, and if upon further consideration of the act of last year such a substitution should be thought to be beyond the scope of the powers of the Commission, application for an amendment could be made to the Legislature at its next session without delaying the work.

Such being the views entertained by the Commission it cannot with propriety, at the very end of the session, apply to the Legislature for a change in the law, and the Commission after reconsideration of its vote of 29th of May relating to the expediency of asking at the present time for additional legislation, adheres to the conclusion then reached.

BOSTON TRANSIT COMMISSION,

(Signed)

By GEORGE G. CROCKER,

Chairman.

Washington street as a route for the tunnel having been removed from consideration, so far as the Commission was concerned, the officials of the Boston Elevated Railway Company were asked to express their opinion as to which one of the remaining routes seemed to them most desirable. This conference was held June 19, at which the representatives of the company unofficially expressed a preference for the May-place and Devonshire-street route, so-called, with no station between Dover and Summer streets. It was distinctly understood, however, that this was only the opinion of the company as to the best of the east side routes, so-called, and that in expressing such opinion it did not abandon its desire for the Washington-street route. On June 29 the Commission decided upon the route by the following vote :

Voted, That the route which may be designated as the "May place-Devonshire street-Union street route," from a point between Oak and Nassau streets to a point under Union street near Haymarket square, substantially as shown in red on plan # 5961, signed by the Chief Engineer, having stations in the vicinity of Summer street and State street, and such other stations, if any, as may hereafter be determined upon, be adopted as the route for a two track tunnel for the use of elevated cars or trains, as provided for in chapter 534, acts of 1902, and that written notice of this vote be sent to the Boston Elevated Railway Company.

An attested copy of this vote was delivered at the office of the company at 2.45 P.M. of the same day. By the terms of section 13 of the act the company may, within three days from that date, apply to the Board of Railroad Commissioners for a revision of this determination, which may be considered and finally determined by that Board.

SUBWAY.

A permanent sidewalk has been placed about the entrance at Pleasant street.

Electrolysis.

The following correspondence is self-explanatory :

BOSTON, January 23, 1903.

BOSTON ELEVATED RAILWAY CO., WILLIAM A. BANCROFT, *President*:

DEAR SIR: Will you be kind enough to furnish the Commission with a statement as to any examinations which you have had made as to the effect of electrolysis on the steelwork in the subway?

Yours very truly,

(Signed)

GEORGE G. CROCKER,
Chairman.

PRESIDENT'S OFFICE,

101 MILK STREET, BOSTON, MASS., January 24, 1903.

GEO. G. CROCKER, *Chairman, Boston Transit Commission, 20 Beacon Street, Boston, Mass.:*

DEAR SIR: In response to your letter of January 23rd, current,—I find, upon inquiry, that we have made careful examinations of the bonding of our steel rails in the subway, and have also made some cursory examinations of the steel structure of the subway itself, but have never found any evidence of conditions tending to electrolytic action therein.

Respectfully,

(Signed)

WM. A. BANCROFT,
President.

Subsequently the President of the company orally agreed to have the subway examined at regular intervals for electrolysis and to make report to the Commission.

Payment of Rental under the Toll System.

The contract with the West End Street Railway Company for the use of the subway provides that all cars of 25 feet or less body length passing through the subway in either direction shall be reckoned at 5 cents per car, and all such cars passing through a portion of the subway in one direction, reversing direction within the subway and making a return trip, shall be reckoned at 10 cents per car, and any excess of body length over 25 feet shall be reckoned at a proportional increase over these sums; and if, in any one quarter, the amount so computed exceeds the rental which the company would pay on the basis of $4\frac{7}{8}$ per cent annually upon the net cost of the subway, the company shall pay such excess.

Nov. 15, 1902, the following was received:

AUDITOR'S OFFICE,

101 MILK STREET, BOSTON, MASS., Nov. 15th, 1902.

MR. B. LEIGHTON BEAL, *Secy., Boston Transit Commission, 20 Beacon Street, City:*

DEAR SIR: I regret to say that upon carefully analyzing the number of trips, which we have run through the subway, I have discovered that for the quarters ending Sept. 30th, 1901, Dec. 31st, 1901, June 30th, 1902 and Sept. 30th, 1902, we ran a greater number than was permitted under the terms of our contract whereby we were to pay $4\frac{7}{8}$ per cent upon

the cost of the subway, and for those quarters we must pay at the rate of 5 cents per trip for a car not exceeding 25 ft. in body length and for longer cars a proportionately greater amount. We, therefore, enclose herewith voucher in favor of the City of Boston, together with a check on the National Union Bank for \$5,623.04.

For the quarter ending in March, 1902, we ran 1,038,097 single trips, and these on the basis of 5 cents each amounted to \$1,393.48 less than the amount of the bill which was rendered.

Very truly yours,

(Signed)

H. L. WILSON,
Auditor.

Enclosures.

For additional amounts due for use of the Subway for the quarters ending Sept. 30, 1901, Dec. 31, 1901, June 30, 1902 and Sept. 30, 1902.

Sept. 30, 1901:			
1,106,682 single trips run as provided in lease at 5 cts. each	\$55,334	10	
Amount of bill rendered on basis of 4½% of cost	53,414	27	
			\$1,919 83
Dec. 31, 1901:			
1,081,614 single trips at 5 c. each	\$54,080	70	
Amount of bill	53,444	83	
			635 87
June 30, 1902:			
1,101,362 single trips at 5 c. each	\$55,068	10	
Amount of bill	53,329	46	
			1,738 64
Sept. 30, 1902:			
1,093,197 single trips at 5 c. each	\$54,659	85	
Amount of bill	53,331	15	
			1,328 70
Total			\$5,623 04

SINKING FUNDS.

The following is the condition of the debt and of the sinking funds for the various divisions of the work of the Commission at the date of this report:

SUBWAY (INCLUDING ALTERATIONS).

(Debt, \$4,416,000, outside debt limit.)

Amount of fund, July 1, 1902		\$523,664 97
Interest on bank deposits, July 1, 1902, to date	\$1,234 46	
Interest on investments, July 1, 1902, to date	17,018 21	
Revenue received, July 1, 1902, to date	49,132 26	
		67,384 93
		<u>\$591,049 90</u>

CHARLESTOWN BRIDGE, No. 1.

(Debt, \$750,000, inside debt limit.)

Amount of fund, July 1, 1902		\$73,494 64
Interest on bank deposits, July 1, 1902, to date	\$489 01	
Interest on investments, July 1, 1902, to date	2,272 97	
Revenue received, July 1, 1902, to date	576 33	
Requirement for debt	8,633 00	
	<hr/>	11,971 31
		<hr/>
		\$85,465 95

CHARLESTOWN BRIDGE, No. 2.

(Debt, \$805,000, outside debt limit.)

Amount of fund, July 1, 1902		\$83,924 41
Interest on bank deposits, July 1, 1902, to date	\$259 86	
Interest on investments, July 1, 1902, to date	2,506 00	
Requirement for debt	8,001 00	
	<hr/>	10,766 86
		<hr/>
		\$94,691 27

EAST BOSTON TUNNEL.

(Debt, \$2,885,000, outside debt limit.)

Amount of fund, July 1, 1902		\$21,600 00
Interest on bank deposits, July 1, 1902, to date		684 53
		<hr/>
		\$22,284 53

AMOUNTS PAID FOR RENTAL OF THE SUBWAY.

The following sums have been paid during the year by the Boston Elevated Railway Company for the use of the subway :

Sept. 30, 1902:

Total cost of subway	\$4,133,287 23
Rebate, as per vote of Commission, July 10, 1902	187 59

Net cost	\$4,133,099 64
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One quarter's rental	\$50,372 15
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Less $4\frac{1}{2}$ per cent for three months on \$187.59, abated in accordance with vote of Commission, July 10, 1902

2 29

Net rental for one quarter	\$50,369 86
Alterations: net cost	242,977 23
One quarter's rental	2,961 29

Dec. 31, 1902:

Net cost of subway	4,133,204 64
One quarter's rental	50,373 43
Alterations: net cost	242,977 23
One quarter's rental	2,961 29

Carried forward	\$106,665 87
---------------------------	--------------

<i>Brought forward</i>		\$106,665 87
March 31, 1903:		
Net cost of subway	4,133,586 52	
One quarter's rental		50,378 09
Alterations: net cost	243,238 77	
One quarter's rental		2,964 47
June 30, 1903:		
Net cost of subway	4,134,531 61	
One quarter's rental		50,389 61
Alterations: net cost	243,238 77	
One quarter's rental		2,964 47
		<u>\$213,362 51</u>

STATEMENT OF EXPENSES.

The following is a classified statement of the expenses of the Commission for the year ending June 30, 1903:

SUBWAY.

ENGINEERING DEPARTMENT.

Labor	\$297 50	\$297 50
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SECTION THREE.

Labor	\$2 45	2 45
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SECTION FIVE.

Labor	\$49 36	
Construction	381 88	
Field supplies	264 75	
	<u> </u>	695 99

SECTION SEVEN.

Field supplies	\$354 99	354 99
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SECTION EIGHT.

Labor	\$11 59	11 59
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SECTION EIGHT AND ONE-HALF.

Labor	\$11 60	11 60
-----------------	---------	-------

SECTION TEN.

Construction	\$620 00	
Labor	41 83	
	<u> </u>	661 83

SECTION ELEVEN.

Construction	\$100 00	
Inspection	5 00	
	<u> </u>	105 00

ALTERATIONS.

SECTION SEVEN.

Construction	\$261 54	261 54
<i>Carried forward</i>		<u>\$2,402 49</u>

Brought forward \$2,402 49

EAST BOSTON TUNNEL.

General Expenses :

Office — Repairs	\$24 42
Furniture	26 75
Supplies	765 71
Stationery and print- ing	218 51
Fuel and light	222 33
Rental	1,500 00
Stenographers	2,393 04
Messenger	936 00
Clerks	885 33
Janitor	269 10
Salaries of Commissioners and Secretary	28,100 00

\$35,341 19

Transferred to Boston Tunnel
and Subway 13,563 81

Balance General Expenses, East Boston

Tunnel \$21,777 38

Proportion of salary of Chief Engineer . . . 6,680 50

28,457 88

ENGINEERING DEPARTMENT.

Rooms — Repairs	\$6 18
Furniture	33 79
Supplies	1,260 12
Stationery and printing	3,201 80
Fuel and light	223 08
Rental	1,500 00
Janitor	269 10
Messenger	684 88
Stenographers	2,372 66
Clerks	2 67
Instruments	193 45
Skilled service	26,756 01

36,503 74

MISCELLANEOUS.

Legal and expert advice	\$29 00
Teaming	81 95
Field supplies	8,458 41
Labor	609 83

9,179 19

SECTION A.

(In Maverick square and Lewis street, East Boston, to a
point 100 feet southwest of Webster street.)

Field supplies	\$58 04
Inspection	11 20
Labor	126 60

195 84

Carried forward \$76,739 14

Brought forward \$76,739 14

SECTION B.

(From a point in Lewis street 100 feet southwest of Webster street, East Boston, under harbor between South Ferry slip on the East Boston side and Long wharf on the Boston side, State street.)

Boston Tunnel Construction Company	\$462,459 32	
Construction	14,367 25	
Office supplies	580 39	
Field supplies	781 93	
Labor	1,292 66	
Teaming	1 50	
Stationery and printing	9 75	
Legal and expert advice	1,261 40	
Skilled service	933 44	
Inspection	8,776 91	
Instruments	92 39	
Rental	180 00	
Water-pipes	391 24	
	<hr/>	491,128 18

SECTION C.

(Under State street from India street to near Atlantic avenue.)

Patrick McGovern (Contract No. 188)	\$113,920 75	
Gow & Foss	51,301 70	
Construction	52,777 39	
Office supplies	536 92	
Instruments	24 20	
Insurance	240 28	
Advertising	46 51	
Field supplies	54,699 89	
Labor	1,499 57	
Teaming	67 44	
Underpinning	2,122 67	
Inspection	2,900 17	
Water-pipes	3 60	
Skilled service	343 49	
Rental	270 82	
Legal and expert advice	586 70	
	<hr/>	281,342 10

SECTION D.

(In State street between India street and Congress street.)

H. P. Nawn	\$26,119 90	
Patrick McGovern (Contract No. 179)	95,735 52	
Patrick McGovern (Contract No. 188)	19,609 70	
Gow & Foss (Contract No. 174)	13,786 62	
Gow & Foss (Sewer, Merchants' row)	436 34	
Gow & Foss (Sewer, Exchange Building)	2,271 19	
Gow & Foss (Sewer, Fiske Building)	1,432 22	
Advertising	75 93	
Construction	27,059 03	
Field supplies	8,219 41	
Office supplies	190 83	
Legal and expert advice	316 60	
	<hr/>	
<i>Carried forward</i>	\$195,253 29	\$849,209 42

<i>Brought forward</i>	\$195,253 29	\$849,209 42
Teaming	88 99	
Labor	2,765 43	
Rental	187 51	
Inspection	3,619 89	
Skilled service	135 88	
Stationery and printing	8 25	
Water-pipes	2,615 04	
Instruments	7 45	
Electric conduits	175 55	
		204,857 28

SECTION E.

(Station under the Old State House near the head of State street.)

H. P. Nawn	\$36,397 21	
Woodbury & Leighton	19,895 24	
G. W. & F. Smith Iron Company	1,806 61	
Patrick McGovern (Contract No. 179)	910 74	
Gow & Foss (Sewer, Old State House)	3,797 43	
Gow & Foss (Contract No. 176, Pipe Crossing)	2,795 70	
Gow & Foss (Contract No. 181)	21,289 00	
Eastern Bridge and Structural Company	14,671 01	
Construction	17,287 02	
Office supplies	88 17	
Field supplies	2,426 82	
Advertising	126 83	
Labor	3,431 18	
Inspection	2,839 38	
Skilled service	724 02	
Water-pipes	2,804 19	
Instruments	45 61	
Furniture	13 00	
Insurance	162 00	
Electric conduits	87 77	
Legal and expert advice	193 30	
Teaming	134 87	
		131,927 10

SECTION F.

(From the westerly end of the Old State House across Washington street and along Court street to near Tremont street.)

Patrick McGovern (Contract No. 179)	\$10,729 75	
Construction	240 62	
Labor	491 88	
Inspection	419 11	
Office supplies	4 15	
Field supplies	217 89	
Skilled service	125 31	
Teaming	15 05	
		12,243 76

BOSTON TUNNEL AND SUBWAY.

General Expenses:

Amount transferred from East Boston tunnel, general expenses	\$13,563 81	
Proportion of salary of Chief Engineer	4,319 50	
Office supplies	69 59	

Carried forward \$17,952 90 \$1,198,237 56

<i>Brought forward</i>	\$17,952 90	\$1,198,237 56
Office stationery	545 80	
Eng. stationery	2 00	
Tools	5 70	
Skilled service	5,260 64	
Draughting supplies	26	
Eng. stenographers	101 76	
Eng. messenger	2 14	
Legal and expert advice	400 00	
Travel	134 38	
Eng. printing	7 45	
Borings:		
P. J. Healey	781 68	
Materials	14 43	
Labor	31 98	
		25,241 12

CHARLESTOWN BRIDGE.

Grade damages	\$7,478 60	7,478 60
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INTEREST.

East Boston Tunnel		56,961 10
Grand Total		<u>\$1,287,918 38</u>

SUMMARY.

	From beginning of work to June 30, 1902.	June 30, 1902, to June 30, 1903.	Total.
Subway. — Subway Com- mission	\$14,131 16		\$14,131 16
Part of General Ex- penses	117,473 24		117,473 24
Engineering and Mis- cellaneous	407,135 56	\$297 50	407,433 06
Section One	240,651 71		240,651 71
Two	364,892 05		364,892 05
Three	308,031 21	2 45	308,033 66
Three and one- half	9,479 39		9,479 39
Four	475,340 37		475,340 37
Five	387,439 24	695 99	388,135 23
Six	327,494 86		327,494 86
Seven	234,528 43	354 99	234,883 42
Eight	99,878 67	11 59	99,890 26
Eight and one- half	77,390 39	11 60	77,401 99
Nine	304,668 85		304,668 85
Ten	259,278 32	661 83	259,940 15
Eleven	270,205 57	105 00	270,310 57
Interest	258,575 60		258,575 60
Total	<u>\$4,156,594 62</u>	<u>\$2,140 95</u>	<u>\$4,158,735 57</u>

	From beginning of work to June 30, 1902.	June 30, 1902, to June 30, 1903.	Total.
Alterations. — Part of			
General Expenses . . .	\$28,945 53		\$28,945 53
Section Three . . .	2,568 26		2,568 26
Four . . .	163 42		163 42
Five . . .	30,233 01		30,233 01
Seven . . .	178,824 41	\$261 54	179,085 95
Nine . . .	3 00		3 00
Ten . . .	534 04		534 04
Interest . . .	1,905 56		1,905 56
Total . . .	<u>\$243,177 23</u>	<u>\$261 54</u>	<u>\$243,438 77</u>
East Boston Tunnel. —			
Part of General Ex-			
penses . . .	\$107,046 00	\$28,457 88	\$135,503 88
Engineering Expenses .	94,497 16	45,682 93	140,180 09
Section A . . .	95,272 79	195 84	95,468 63
B . . .	463,596 63	491,128 18	954,724 81
C . . .	52,874 52	281,342 10	334,216 62
D . . .	10,624 68	204,857 28	215,481 96
E . . .		131,927 10	131,927 10
F . . .		12,243 76	12,243 76
Interest . . .	46,900 00	56,961 10	103,861 10
Total . . .	<u>\$870,811 78</u>	<u>\$1,252,796 17</u>	<u>\$2,123,607 95</u>
Boston Tunnel and Sub-			
way. — Part of Gen-			
eral Expenses . . .		\$17,883 31	\$17,883 31
Engineering Expenses .		7,357 81	7,357 81
Total . . .		<u>\$25,241 12</u>	<u>\$25,241 12</u>
Bridge. — Part of Gen-			
eral Expenses . . .	\$53,820 57		\$53,820 57
Construction, etc. . .	1,508,892 31	\$7,478 60	1,516,370 91
Total . . .	<u>\$1,562,712 88</u>	<u>\$7,478 60</u>	<u>\$1,570,191 48</u>
Grand Total . . .	<u>\$6,833,296 51</u>	<u>\$1,287,918 38</u>	<u>\$8,121,214 89</u>

The report of the Chief Engineer is appended.

GEORGE G. CROCKER, CHARLES H. DALTON, THOMAS J. GARGAN, GEORGE F. SWAIN, HORACE G. ALLEN,	} } } } }	<i>Boston Transit Commission.</i>
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REPORT OF THE CHIEF ENGINEER.

BOSTON, June 30, 1903.

GEORGE G. CROCKER, CHARLES H. DALTON, THOMAS J.
GARGAN, GEORGE F. SWAIN, HORACE G. ALLEN,
Boston Transit Commissioners:

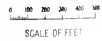
GENTLEMEN: The Engineering Department has been mainly engaged during the past year under your direction in making plans and specifications and supervising the work of construction of the East Boston Tunnel, and in making studies for the additional subway and tunnel provided for in the legislative statutes of 1902.

THE EAST BOSTON TUNNEL.

The longitudinal division of the Tunnel designated as Section A, in East Boston, was substantially completed in November, 1900. Nothing has been done on it this year except to begin a stairway over the raised portion in Maverick square. Reference is made to this on page 10 and in Appendix W. Section B, which at the date of the last Annual Report had been built to about midway between the shore lines of Boston and East Boston, has now been advanced nearly to Atlantic avenue. Section C, which extends under State street from near Atlantic avenue to near the middle of India street, has been tunnelled from the latter street easterly as far as the westerly end of the proposed passenger station at the foot of State street. Work is now progressing satisfactorily on the wide arch of this station. Section D, extending under State street from the shaft at India street to near Congress street, has been practically completed. Section E, which mainly consists of a station under and east of the Old State House, will require at the present rate of progress some months of additional work. The most westerly division of the Tunnel is Section F, from the Old State House to Scollay square. The work on this section has been delayed by conferences and negotiations (referred to on pages 3 to 7) with the Elevated Company which were practically required by law. The various questions have now been settled and the work of construction will soon begin.

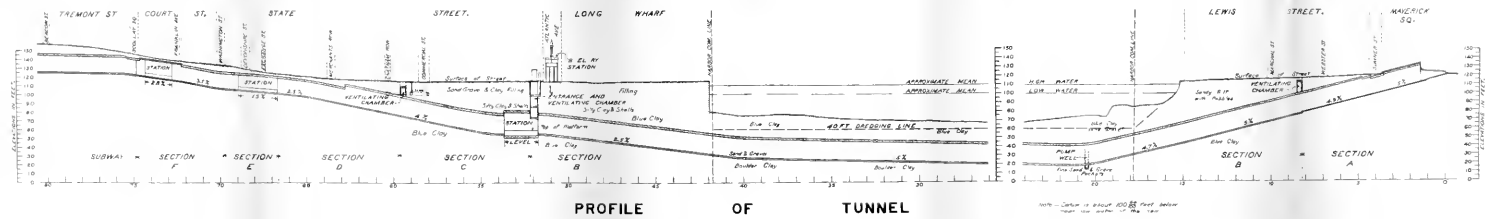
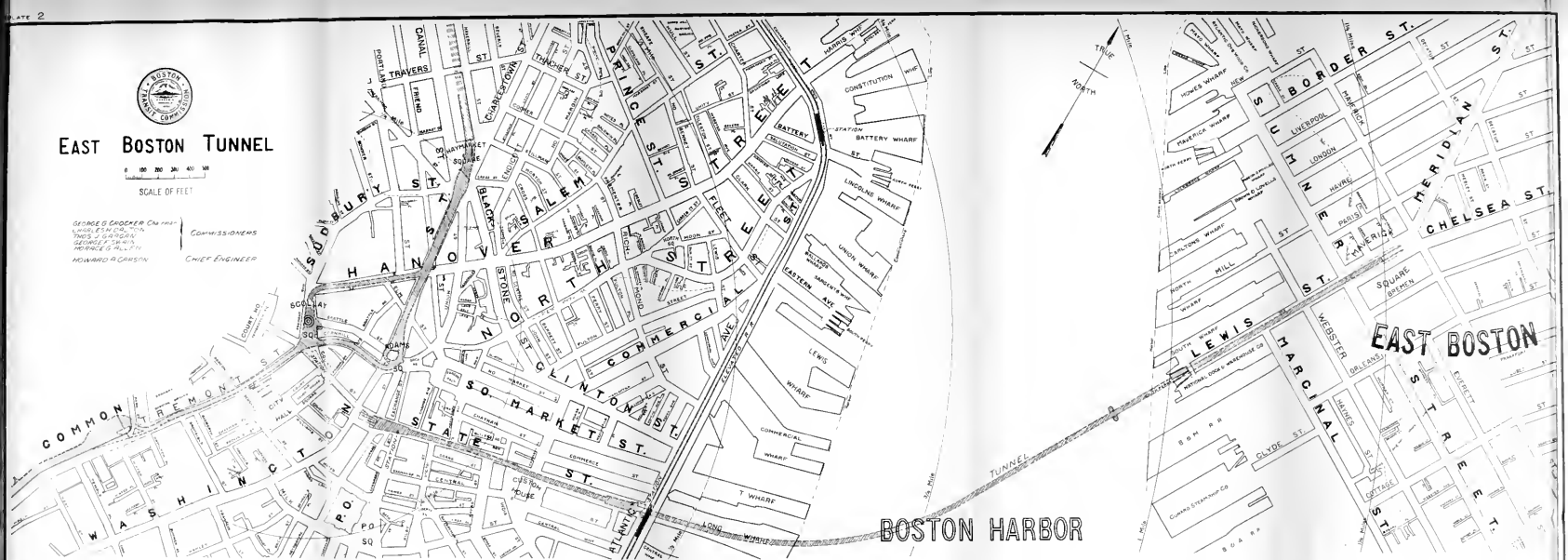


EAST BOSTON TUNNEL



GEORGE S. BROOKER, CH. ASST.
WILLIAM F. CROFT, CH. ENG.
THOMAS J. GARDEN, CH. ASST.
GEORGE S. HARRIS, CH. ASST.
HOWARD A. GIBSON, CH. ASST.

COMMISSIONERS
CHIEF ENGINEER



PROFILE OF TUNNEL

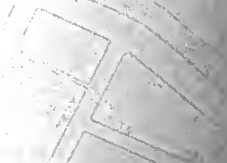
NOTE - Tunnel is about 100 feet below water surface at the pier.

7-10



2000

1532



A detailed description, made largely from reports of my assistants, of the work on the various sections is given in the following pages.

The names of the resident engineer and of the contracting firms are given in the text. Most of the field work being carried on night and day, there were in many cases three sets of engineering assistants and inspectors. Appendix D gives the names of all assistants who have been employed for more than one month during the last year. Appendix E gives the names of nearly all the contractors, and in some cases of their principal foremen.

SECTION B OF THE EAST BOSTON TUNNEL (CONTRACT WORK).

Contractors for Construction.—The Boston Tunnel Construction Company.

Transit Commission Resident Engineer.—John E. Palmer.

Date of contract.

June 28, 1900.

Date of completion
named in contract.

June 15, 1903.

Tunnel Portion.

Some details relative to the progress are given in the following tables:

Progress.

Items.	Excavation.	Concrete.	Linear feet.
Date of beginning.....	Aug. 13, 1900	Sept. 19, 1900	
Amount of work done previous to June 30, 1902.....	<i>Cubic yards.</i> 50,640	<i>Cubic yards.</i> 16,535	2,064
Amount of work done during year ending June 30, 1903.....	49,200	17,425	3,029
Total amount work done.....	99,840	33,960	4,274
Maximum progress per week dur- ing year ending June 30, 1903.	1,400	460	575
Total estimated quantities.....	100,900	35,000	4,351

Progress of Section B of the East Boston Tunnel each three months from time of completion of the shaft on Jan. 26, 1901, to the date of this report, *i.e.*, June 30, 1903:

	Distance from Maverick square.	Progress during quarter, feet.	Remarks.
April 27, 1901.....	1,082	228	} Installing plant and air locks during this period.
July 27, 1901.....	1,363	281	
Oct. 26, 1901.....	1,773	410	
Feb 1, 1902.....	2,113	340	} Changing working tracks dur- ing this period.
May 3, 1902.....	2,583	470	
Aug. 2, 1902.....	3,083	500	
Nov 1, 1902.....	3,633	550	
Jan 31, 1903.....	4,178	545	
May 2, 1903.....	4,763	585	
• June 30, 1903 (59 days)	5,078	315	

Two accidents, described later, occurred during the year, but on the whole there has been little interruption in the progress of the work. The whole section is nearly completed, including the pump chambers. There remains to be done 62.5 feet of Tunnel under Atlantic avenue, the ventilating chamber at the shaft in Lewis street between Webster and Marginal streets, East Boston, the Atlantic Chambers and Marginal streets, the cleaning of the Tunnel of lumber, rails, and rubbish that has accumulated during the progress of the work, and various minor matters. There has been no change in the plant during the year.

The work has been carried on with two shifts, day and night, of 10 hours each with about 130 men and 14 mules for each shift.

Work on the arch was stopped at Station 37 + 77.50 Nov. 18, 1902, by breaks occurring in the running plates (longitudinal I-beams over the rollers) of the shield from 12 to 15 inches back of their forward ends. The plates had been crippled for some months, but not enough to make it necessary to stop work. At the locality of the break the walls were left 4 inches low for a distance of 10 feet for the purpose of repairing the crippled plates, and the low place had been built up temporarily with wooden blocks. In moving over these blocks the wood crushed, and in running on to the wall beyond the plates gave way. New plates

were put in on both sides, and the shield again began its progress on the evening of November 26th.

The method of tunnelling during the last year has been as before, that of a roof shield running on side walls built in advanced drifts. This method was described and illustrated on page 23 of the Seventh Annual Report.

Beginning with the curve near the middle of the harbor (¹ Station 30 + 10) the Tunnel is made 4 inches wider than the straight portion theretofore built, changing the inside diameter at the springing line from 23 feet 4 inches to 23 feet 8 inches.

At a point nearly under the Harbor Commissioners' line on the Boston side (Station 41 + 65), where the greatest weight on the masonry is encountered, the invert was made more convex and increased in depth one foot. This change was made gradually so as to maintain a slope on the inner surface for drainage purposes.

Character of Earth Penetrated. — During the period covered by this report the excavation has been mainly of blue clay. Through a portion 600 feet long, however (Station 29 + 50 to 35 + 50), boulder clay, with a large proportion of sand and gravel, was found from 1 to 8 feet above the bottom of the Tunnel. Through a stretch 250 feet long (Station 39 to 41 + 50) a similar formation was encountered, except that there was much more sand, and it extended as high as 18 feet above the bottom of the Tunnel at Station 39 + 70. Through this stratum of sand, gravel, and boulder clay four inches or more of plastic clay was packed outside the Tunnel masonry as described in the Eighth Annual Report.

On Jan. 1, 1903, the advanced drifts reached the Harbor Commissioners' line, Boston side, under the end of Long wharf, and the shield passed this line January 24. The buildings on Long wharf began to settle slightly in advance of the drift headings, increasing until the arch was completed under them. In the "Custom House Block" on Long wharf the ends and party walls cracked, opening in some instances from two to four inches before they were tied or shored up.

The drifts which had been advancing westerly from East Boston reached, March 18th, a point 452 feet from Atlantic Chambers (Station 47 + 18). On this date miners began excavating a drift eastward from Atlantic Chambers on the north side of Tunnel to meet the northerly drift from East Boston, for the purpose of verifying the lines and eleva-

¹ Stations are 100 feet apart. Station 30 + 10 is 3,010 feet from the easterly end of the tunnel.

tion of Tunnel. When this drift was driven to a point 150 feet from the Atlantic Chambers a clay and timber bulkhead was built across the drift at a point 15 to 20 feet from the Chambers. On Wednesday, May 6, 1903, when the advanced drift of the Tunnel was within 16 feet of test drift (Station 50 + 8) a 2-inch iron pipe was driven through the intervening clay and compressed air was let in, filling the new drift. There was a small leakage of air through or near the bulkhead, and a fall of 2 pounds (per square inch) in the Tunnel air pressure. On May 8, 1903, the intervening portion of the northerly drift was excavated. The line from East Boston had been run through air locks and through a mile (including a long curve) of foggy Tunnel; the outside triangulations across the harbor and connections therewith had not been determined with minute precision because intervening buildings and a smoky atmosphere would have made such precision too costly; the connections of the easterly and westerly drifts were, however, close enough (0'.07 levels and 0'.33 line) for all practical purposes.

It was soon discovered that compressed air was escaping through sand veins north of the bulkhead. This leakage continuing to increase, the joints between the drift timbers were sealed with clay. This clay shrunk and cracked soon after it was applied, and was washed with Portland cement until practically air-tight.

It was decided, on May 11, 1903, to excavate a small drift north and south from the northerly drift, also upward and downward, in an effort to cut sand veins off and prevent the leakage of air. This cut-off was extended northward about 9 feet, without reaching the limit of sand, when it was abandoned and the open space outside of main drift filled up with clay. While this cut-off was being excavated the air pressure in the Tunnel fell to $6\frac{1}{2}$ pounds. The effects of the low pressure were noticed immediately by the crushing of drift timbers, the scantily-braced walls in advance of the shield moved toward each other about 7 inches, and the arch just at the rear of the shield settled $1\frac{1}{2}$ inches. As soon as the cut-off was filled with clay and the inner surface washed over with cement wash, the air-pressure was raised immediately to 12 pounds per square inch, and the work progressed without further trouble from settlement or otherwise. The normal working pressure during the year previous to meeting the test drift was about 22 pounds per square inch.

At a point about 50 feet east of Atlantic avenue an old well of some historical interest was cut off in the north drift under Long wharf (Station 49 + 88) 13.2 feet north of centre line of Tunnel, causing a slight loss of air. According to records

in the Street Laying Out Department the upper portion (35 feet) of this well was built of stone, and below that 62 feet of wooden pipe encasing a lead pipe, making a total depth of 97 feet. The inner diameter of wooden pipe was 4 inches and that of the lead pipe 2 inches. This well was begun June 12 and finished Sept. 6, 1797. Pumping began and water was being sold from it on the 9th and 11th of the same month respectively. The purpose of the well was to furnish fresh water to sea-going vessels.

The most serious accident that has occurred on this work took place about 11 o'clock P.M., June 19, 1903, when the compressed air blew out of the Tunnel, reducing the pressure in a few minutes to that of the normal atmosphere. An examination shortly after showed that the wooden bulk-head at the Tunnel opening into Atlantic Chambers was destroyed, heavy wooden braces were crushed and broken, 370 cubic yards of earth were in the bottom of the chambers, 2 or 3 tons of the steel framework which had been partially erected in the shaft was twisted out of shape, and there was a cavity in the street above where the blow-out occurred about 20 feet square and 10 feet deep. Two men who were working in the drift heading at the time were caught up by the rush of air and carried into an opening in the clay with a force that completely buried one of them from sight, and the other was driven in so far as to be nearly concealed from view. The body of the latter was soon removed, but the former has not been found at the present time (June 30, 1903). Other men working farther back in the drift were tossed and driven about with timbers, wheel-barrows, etc. It was estimated by some of those present in the Tunnel at the time that the air was escaping for about five minutes after the first outburst. There was no apparent damage to the Tunnel on account of the blow-out except that in the Atlantic Chambers already referred to.

Atlantic Chambers — Open-Cut Portion of Section B.

It has been convenient to call the structure at the easterly end of the passenger station at Atlantic avenue "Atlantic Chambers." This will contain stairways, elevators, ticket offices, and the easterly end of the platforms of the station. A description was given of it in the Eighth Annual Report, and the methods of construction were also described. At the time of the last report (June 30, 1902), about one-third of the trench and about one-third of the wall had been completed. As the trench was extended in process of construction, the amount of water which leaked through the stratum of logs, stone, and filled material of course in-

creased. An Emerson pump with a 4-inch suction was put in by the contractor to assist the pulsometer with a 4-inch suction then in use. These pumps were too small to adequately take care of the water which leaked in. To lessen the leakage a trench was dug to the east of the chambers through the leaky stratum and down to the clay. This trench was about 6 feet wide and about 38 feet long. A line of Wakefield sheeting was made on its easterly side, and the trench filled with clay to the surface of the street. Half of the cost of this dam was borne by the Transit Commission on the ground that it might lessen the cost of construction of Section C. The leakage was lessened for a time, but the water finally came through under and around the dam. A second dam was built November 1 to November 29 farther east and reached a line of clay "boxing" on each side of the street put in in former years to lessen or prevent leakage into the cellars. This dam was about 6 feet wide, 30 feet deep, and 38 feet long. The concrete walls were finally completed April 25, 1903, and excavation of the core, by means of a stiff-legged derrick, began on the same day. The side walls of the chamber in connection with the roof, invert and intervening floors were designed to be of ample strength when completed to withstand the side pressure of the surrounding earth, but required temporary bracing until completion. The contractors excavated the core to a depth of 16 feet before putting in any bracing. Cracks appeared in the walls and thereafter some braces were put in from time to time, until the movement of the walls inward was apparently arrested. These will receive whatever repairs or renewals are needed. The core excavation was finished May 29, the invert or floor of the chambers was built, and on June 13 the first steel was put in place.

Progress on Atlantic Avenue Chambers.

Items.	Excavations.	Concrete.	Steel.
Date of beginning	Dec. 5, 1901.	Feb. 6, 1902.	
Amount of work done previous to June 30, 1902	<i>Cubic Yards.</i> 1,600	<i>Cubic Yards.</i> 310	<i>Tons.</i>
Amount of work done during year ending June 30, 1903.....	5,100	890	6
Total estimated quantities....	6,700	1,400	80

SECTION C OF THE EAST BOSTON TUNNEL.

Contractor for Construction. — Patrick McGovern.

Superintendent for Contractor. — Charles R. Gow.

Transit Commission Resident Engineer. — John E. Palmer.

Date of
contract.
June 20, 1903.

Date of completion
named in contract.
Nov. 15, 1903.

Location. — This section extends from a point about the middle of India street along State street, about 750 feet east to Atlantic Chambers, 75 feet west of Atlantic avenue. The easterly 149.25 feet of this section is a wide arch passenger station, joining the Atlantic Chambers.

General Description of Structure. — The main portion of this section or Tunnel proper is 23 feet 8 inches wide and 20 feet 8 inches in height, inside measurements. The arch is 31 inches, walls from 31 to 33 inches, and invert 24 inches thick. The passenger station portion is 40 feet 6 inches wide and 26 feet in height, inside measurements. The invert of the station is uniformly 3 feet thick, walls 4 feet 3 inches, and the arch 3 feet thick for 122.5 feet and 3 feet 6 inches for the 26.75 feet at the easterly end. The cross-section of the platform part of the station is shown on Plate 9.

Details of Construction. — The first 337.5 feet of this section (Station 56 + 26.5 to 59 + 64) was built by Gow & Foss, Contractors, in a series of small contracts in which the work was at all times under the control and direction of the Transit Commission. The remainder of the section was done by contract similar in form to that of other portions of the Tunnel. The methods of construction employed previous to letting this contract were continued by the contractor.

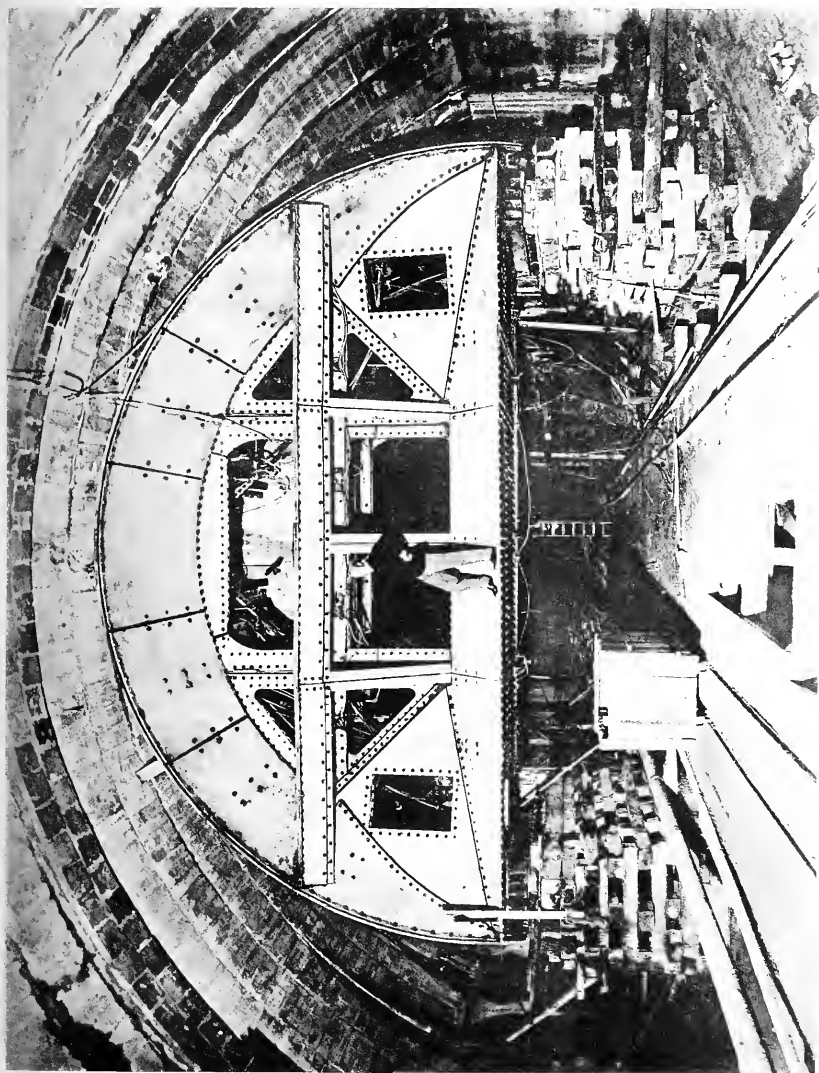
The methods of construction were similar to those employed in Section 6 of the subway and Section B of the Tunnel, and are described in the Eighth Annual Report. The arch was constructed by the aid of a shield described and illustrated in the same report. Further illustrations are given in Plates 4, 5 and 6 of this (Ninth) Report. An upper runway, suspended by iron rods attached to staples, built in the arch for the purpose, was built, extending from the concrete mixer in the shaft to the *upper* air lock, and from the upper air lock on the inside to the shield as a means of transporting concrete cars to and from the concrete mixer to the arch. This was found to be a great convenience, as it relieved

the lower locks (see Plates 7 and 8) and tracks of a large amount of work and facilitated the progress of the work. When the normal Tunnel had been constructed to the westerly end of the passenger station, work with the shield ceased. The successive operations for making the large arch for the passenger station are clearly illustrated by Plate 9.

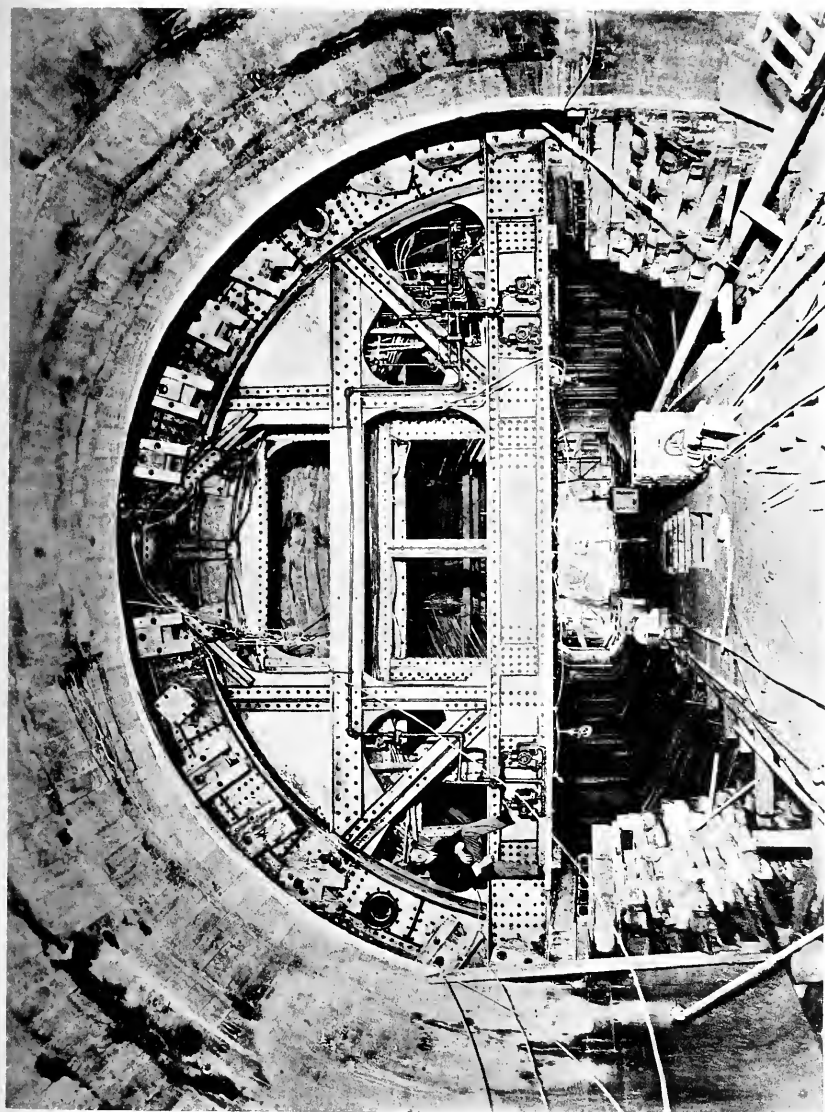
This was done in successive operations, first excavating the lower drifts and building the side walls up about five feet above rail level, and then excavating upper drifts and completing the walls to the springing line of the arch. When a section of wall was completed, a transverse drift was excavated from the centre drifts driven in advance near the crown of the arch. The upper of the two latter drifts was about 6 feet wide and 7 feet high, while the lower, exactly beneath, was about 6 feet wide and 6 feet high, both being continuously timbered by 6-inch by 8-inch spruce. These two drifts are shown by photograph on Plate 3. The transverse drift was so excavated that its upper surface was on the line of the extrados and its lower surface was from 12 to 18 inches below the intrados of the arch. These drifts were excavated of sufficient width to admit building an arch 2 feet 6 inches long. As fast as these transverse drifts were excavated, a sheeting of steel plates each 2 feet 6 inches long by 2 feet wide and one-eighth of an inch thick, with angle iron flanges riveted to the lower surface of the plate for the purpose of bolting the plates together, was placed in position and braced from below. This sheeting was against the earth at the exterior of the excavation and corresponded in position to the extrados of the arch. As soon as one of these transverse drifts was completed, ribs were set and the arch concreted. While the concrete arch was being put in, another transverse drift was excavated, the longitudinal drifts being driven and side walls built in advance of the arch work, so that no one operation was waiting for another. After each short length of arch was completed, the open space, if any, between the steel plates and the earth above or concrete beneath was filled with grout forced through 1½-inch pipes placed in the arch when built. Each arch was allowed to set for thirty days, and thereafter its centre was struck and the corresponding portion of core was removed. As fast as the core was removed the invert was put in in 10-foot sections, thus completing the surrounding shell of concrete. When the station was completed for a sufficient distance, a crib-work was built of heavy timbers on each side as a runway for the shield, the latter was advanced in the usual manner,



SECTION C OF THE EAST BOSTON TUNNEL,—EXCAVATING FOR STATION, SHOWING
TWO UPPER SUPERIMPOSED DRIFTS AND EARTH CORE.
(LOOKING EASTERLY.) MAY 12, 1903.

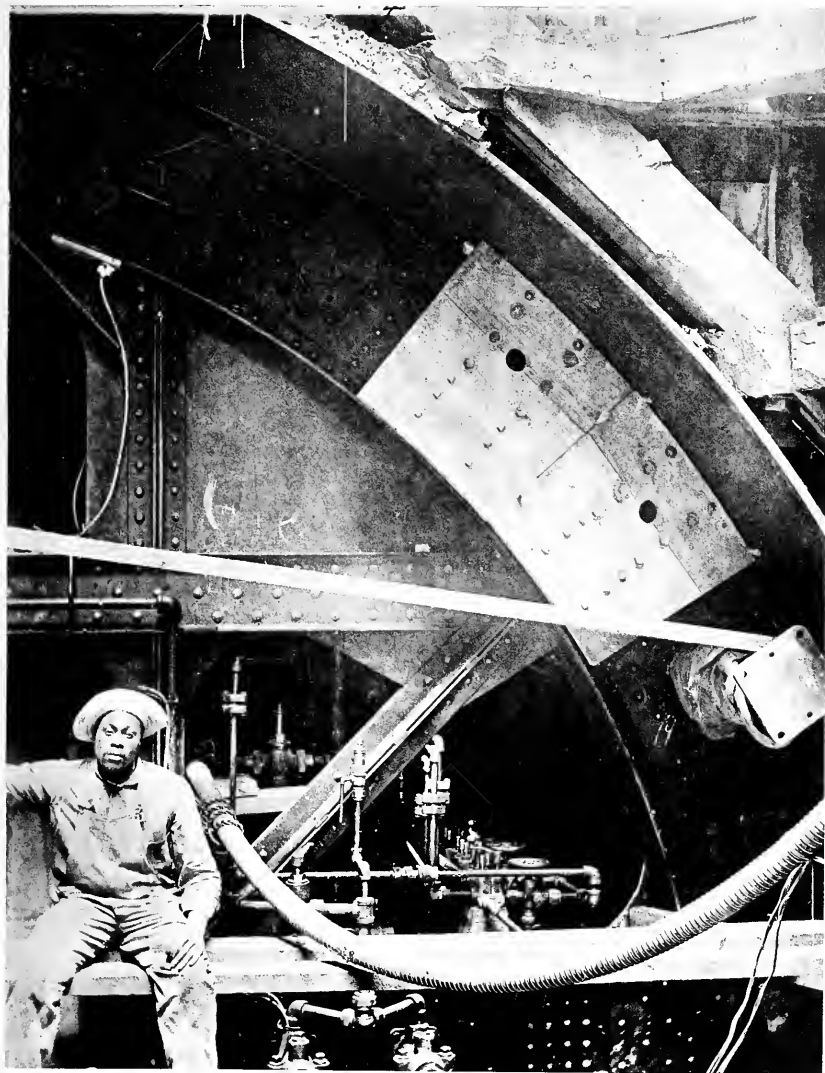


SECTION C OF THE EAST BOSTON TUNNEL,—FRONT OR CUTTING END OF ROOF SHIELD.
THE POSITION OF THE SHIELD IS WHERE ITS WORK WAS FINISHED. ALL EXCEPT
THE REAR END IS UNDER THE LARGE ARCH OF THE PASSENGER STATION.
(LOOKING WESTERLY.)

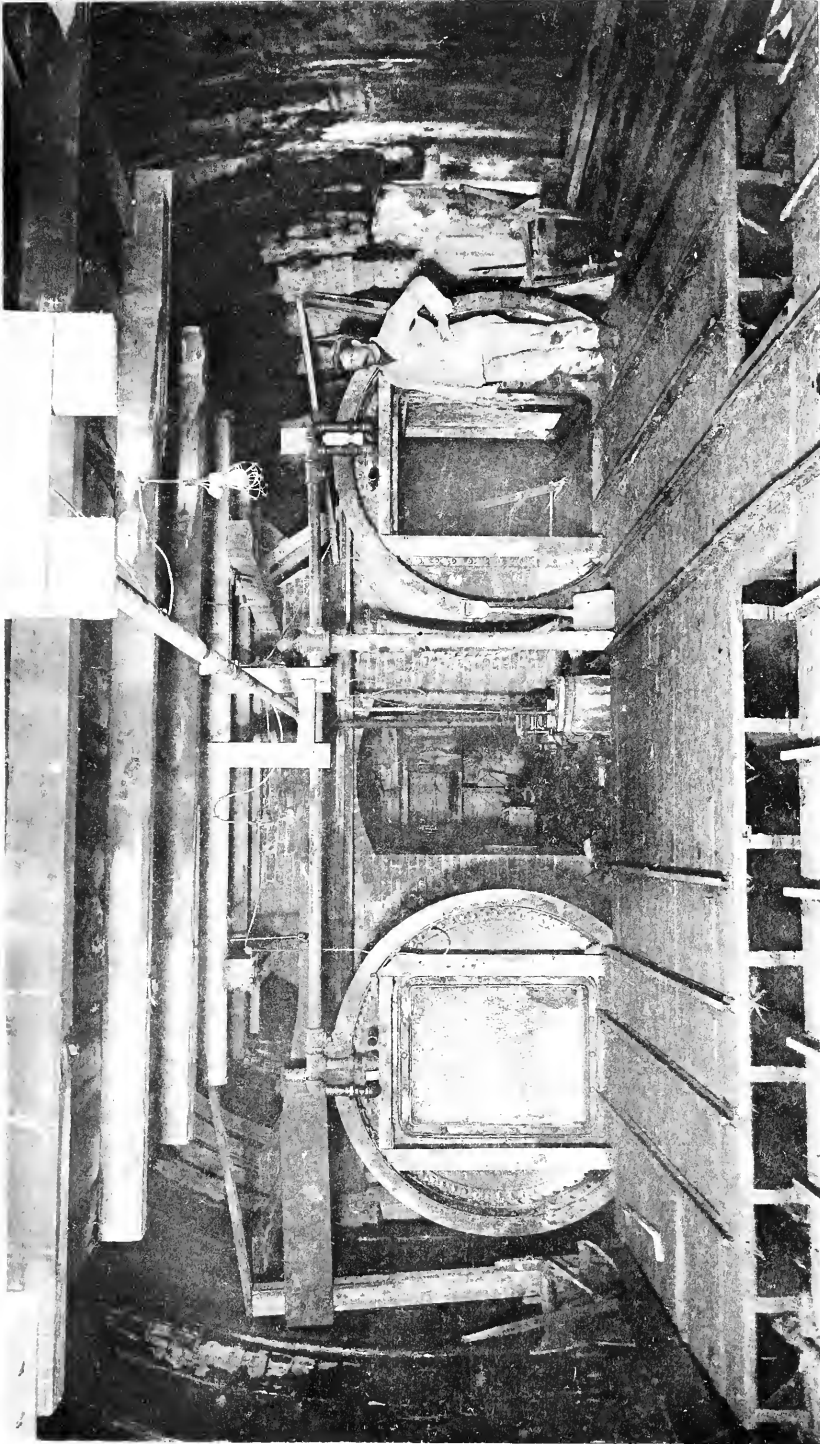


SECTION C OF THE EAST BOSTON TUNNEL,—REAR OF ROOF SHIELD. THE ARCH SHOWN
IS THAT OF THE NORMAL TUNNEL. (LOOKING EASTERLY INTO STATION.)

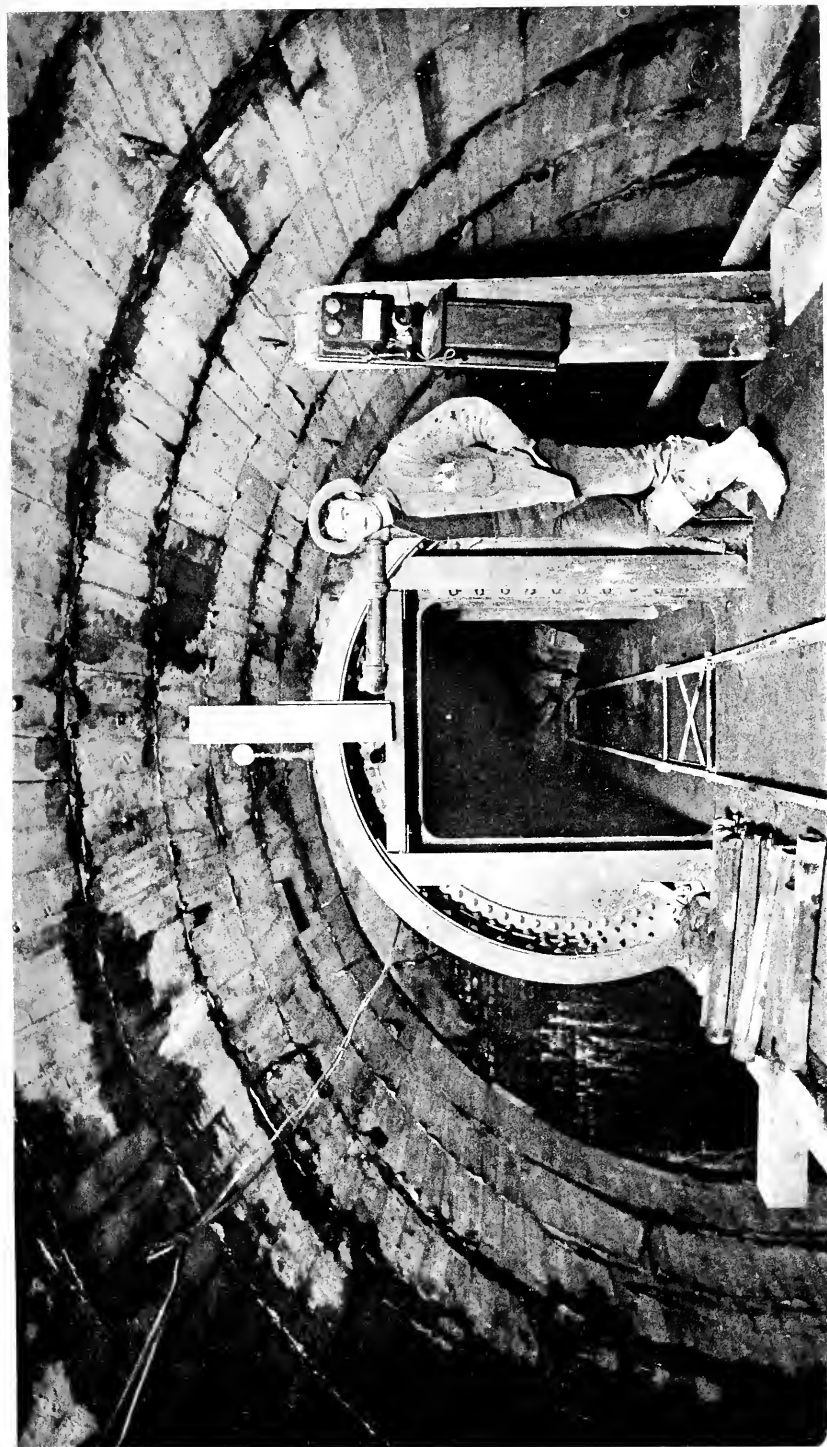




SECTION C OF THE EAST BOSTON TUNNEL,—PORTION OF REAR OF
ROOF SHIELD, SHOWING OPERATING VALVES AND TWO OF THE
BULKHEADS ATTACHED TO THE PLUNGERS OF JACKS.
(VIEW TAKEN AT EASTERLY SIDE OF SHAFT NEAR
CUSTOM HOUSE.) SEPT. 20, 1902.



SECTION C OF THE FISHKILL TUNNEL,--LOWER AIR LOCKS, ALSO TRACKS AND
SLIDING PLATFORMS FOR CONSTRUCTION CARS. STATION 56 + 50.
LOOKING EASTERLY. MARCH 17, 1903.



SECTION C OF THE EAST BOSTON TUNNEL,—UPPER AIR LOCK.
(LOOKING EASTERLY.) MARCH 6, 1903.

and under its tail end the arch of the Tunnel proper was completed. The shield was pushed into the station on the crib-work provided, from which it will be lowered and removed. The last arch of the station was completed on Friday, June 26, 1903. The invert and core are not entirely completed at the present time (June 30, 1903). Most of the water encountered on Section C came from Section D. The most of the section was built under air pressure, which was first used Nov. 28, 1902, and was maintained at 17 pounds per square inch above normal for the greater part of the time. On May 28, 1903, the air blew out through a sand vein on the north side into the shaft at Atlantic Chambers. No damage was done. An air-tight bulkhead was soon built, pressure was put on again and maintained at 10 pounds above normal until finally let off June 10, 1903.

Character of Material. — The material through which this section was built during the last year was largely blue clay, with occasional sand pockets. In the wide arch of the passenger station the upper 3 or 4 feet consisted of black peat, with friable clay immediately beneath, gradually merging into blue clay.

Progress (combining two tables below).

Items.	Excavation.	Concrete.	Linear feet.
Date of beginning.....	March 17, 1902	April 22, 1902	748.25
Amount of work done previous to June 30, 1902	2,833	398	....
Amount of work done during year ending June 30, 1903	17,041	6,126	707
Total amount work done.....	19,874	6,524	707
Maximum progress per week during year ending June 30, 1903	989	289	47.5
Total estimated quantities.....	20,813	6,778	....

DAY WORK. GOW & FOSS. — *Progress.*

Items.	Excavation.	Concrete.	Linear feet.
Date of beginning.....	March 17, 1902	April 22, 1902	323
Amount of work done previous to June 30, 1902	2,833	398	....
Amount of work done to Jan. 26, 1903	5,908	2,100	323
Total amount work done.....	8,741	2,498	323
Maximum progress per week....	....	....	42. 5
Total estimated quantities.....	8,741	2,498	....

P. MCGOVERN. — *Progress.*

Items.	Excavation.	Concrete.	Linear feet.
Date of beginning.....	Jan. 26, 1903	Jan. 26, 1903	425.25
Amount of work done previous to June 30, 1902.....	....	....	....
Amount of work done from Jan. 26 to June 30, 1903.....	11,133	4,026	383
Total amount work done.....	11,133	4,026	383
Maximum progress per week....	989	289	47.5
Total estimated quantities.....	12,072	4,280	....

SECTION D OF THE EAST BOSTON TUNNEL.

Contractors for Construction.

Side walls and sewer, Patrick McGovern.

Roof, H. P. Nawn.

Core and invert, Patrick McGovern.

Transit Commission Engineers.

Side walls and roof, Robert B. Farwell, Assistant Engineer.

Core and invert, John E. Palmer, Assistant Engineer.

	Date of contract.	Date of beginning work.	Date of final certificate.
Side walls.	Aug. 5, 1902.	Aug. 11, 1902.	Nov. 11, 1902.
Roof.	Dec. 17, 1902.	Dec. 20, 1902.	March 5, 1903.

Location. — This section extends from a point near the middle of India street, along State street, to a point near



SECTION D OF THE EAST BOSTON TUNNEL,—STATE STREET DURING
CONSTRUCTION. MUCH OF THE CONFUSION IN THE STREET IS
DUE TO THE CONSTRUCTION ON VARIOUS BUILDINGS.
(LOOKING WESTERLY.) SEPT. 4, 1902.

the westerly end of the Exchange Building and Hospital Life Insurance Building, and is about 700 feet long.

General Description of Structure.—From India street to Butler row, a distance of about 300 feet, the section is a monolithic concrete structure with pointed arch, 23 feet 8 inches wide inside, and 19 feet 10 inches high. From Butler row westerly the section has a flat arch of the same width, and 16 feet 2 inches in height. The thickness of the flat arch is $28\frac{1}{2}$ inches. The section with a flat arch was strengthened by twisted or corrugated steel rods placed in pairs every 30 inches on the inside of the side walls, and in groups of three every 21 inches at the back of the wall. These rods were placed so as to have 2 inches of concrete covering. Two inches from the bottom of the flat roof were placed corrugated rods, in general 4 inches apart on centres, lapping 12 to 18 inches past those in the side walls.

Details of Construction.—In order to maintain the street traffic and a constant sewer service, work was done in the following order: The side walls and side sewers were first built; then the arch, and finally the core was taken out, and the invert put in. From the shaft at the Custom House tunnel drifts were carried (day work) to a short distance beyond the westerly side of Broad street, and a portion of the side walls was constructed therein. In order to ascertain the character of the excavation, and what precautions might be necessary to support adjacent buildings, several test sections 16 to 32 feet in length were opened, and portions of side walls constructed.

The contract for the greater part of the side walls and sewer was awarded to Patrick McGovern. The excavation was by open cut. The length of the opening at the surface was limited to 48 feet, and at no place was the contractor allowed to excavate more than 16 feet in length below the foundation of the adjacent building until the contiguous trench, if previously dug, had received its piece of side wall. In order to lessen interference with street traffic (Plate 10), no holes opposite each other were allowed to be open, and all trenches were planked over. The earth at each opening was raised to the surface by means of an incline or derrick and dumped into carts.

The reconstruction of the sewerage system of State street was necessitated by the fact that the old sewer was in the way of the Tunnel for the entire length of Sections D and E. To take its place a new sewer was built adjacent to the side wall on each side of the street. On the north side of the street a vitrified pipe sewer 15 inches to 20 inches in

diameter was laid, and all existing drains on this side were connected into it. On the south side was built a 2 feet 2 inch by 3 feet 3 inch concrete sewer to which the drains on the south side were connected. The old sewer was then bulkheaded at the corner of India street and put out of use. This sewer had for a long time been in bad condition and at times of heavy rain and high tide caused a great deal of trouble to those engaged in building the Tunnel by overflowing and flooding the trenches and sometimes the shaft at the Custom House, necessitating much pumping.

The contract for building the roof of Section D was let to H. P. Nawn. From India street to Merchants row the excavated material was raised to the surface by a trench machine. The street was excavated to a depth of about 18 inches to 24 inches below the intrados of the arch and mud sills thoroughly imbedded in the earth. Upon these as a foundation wooden forms were set true to the line of the arch, and the arch was then built. After about 24 hours the arch was waterproofed with asphalt, which was covered with a protection layer of concrete 3 inches to 4 inches in thickness. All joints were thoroughly roughened and the joints made with mortar. After the arch had been in place for about 72 hours the street was back-filled over it and repaved and used for traffic. The forms which supported the arch underneath were kept in place for at least a month.

With the side walls and roof in place, the removal of the core became comparatively easy. The work of doing this and putting in the invert was done by Patrick McGovern. Two tracks were laid just above the grade of the invert, and the earth was brought to the India-street shaft in cars. After the bottom had been trimmed to grade, the concrete invert was constructed, clay boxing being placed under it when the natural bed was not of good clay. The work of removing the core was begun April 13, 1903, and the invert was completed June 21, 1903.

The concrete specifications for the side walls required fine crushed stone in place of the usual sand. Subsequently, there being difficulty in obtaining sufficient quantities of the fine stone or "stone dust," part sand was allowed.

The bottom of the structure at India street is about 38 feet below the street surface, diminishing to about 22 feet in front of the Hospital Life Building. The grade from India street to Kilby street is 4 per cent., and from Kilby street westerly 2.5 per cent.

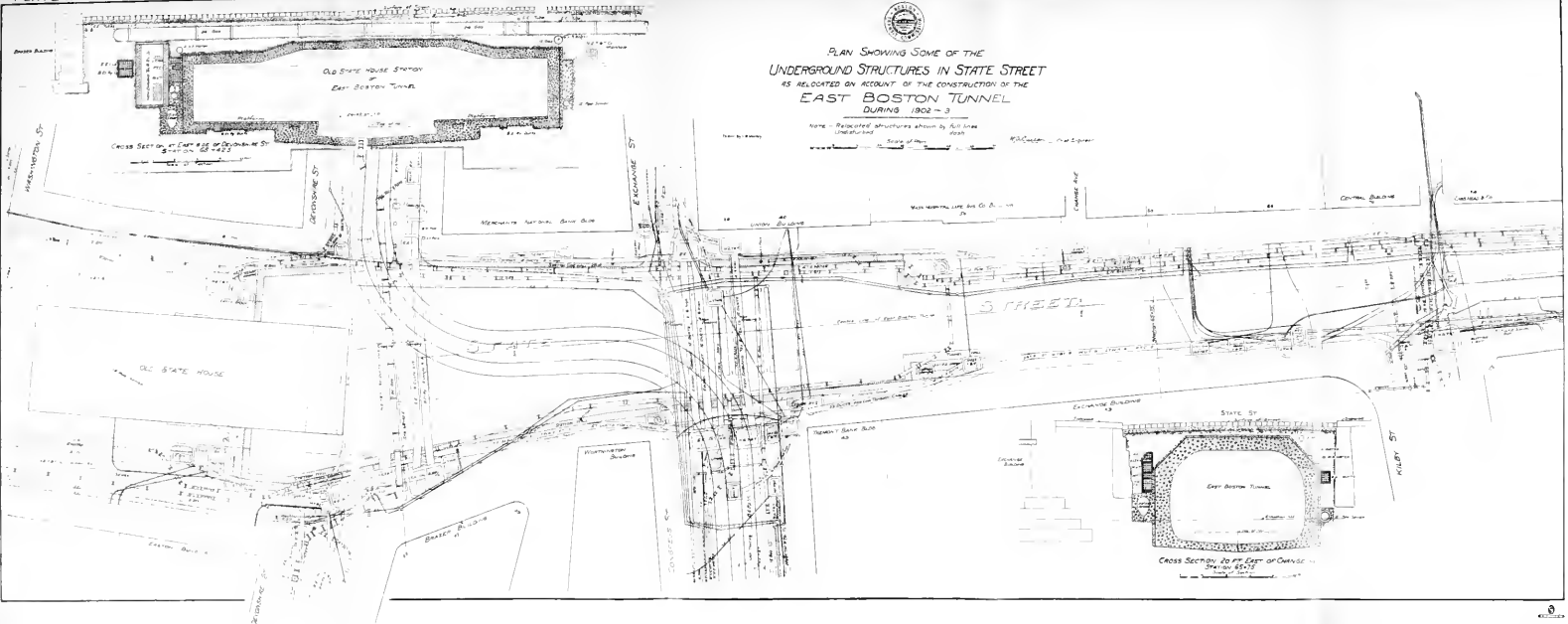
In practically all the operations on Section D the work

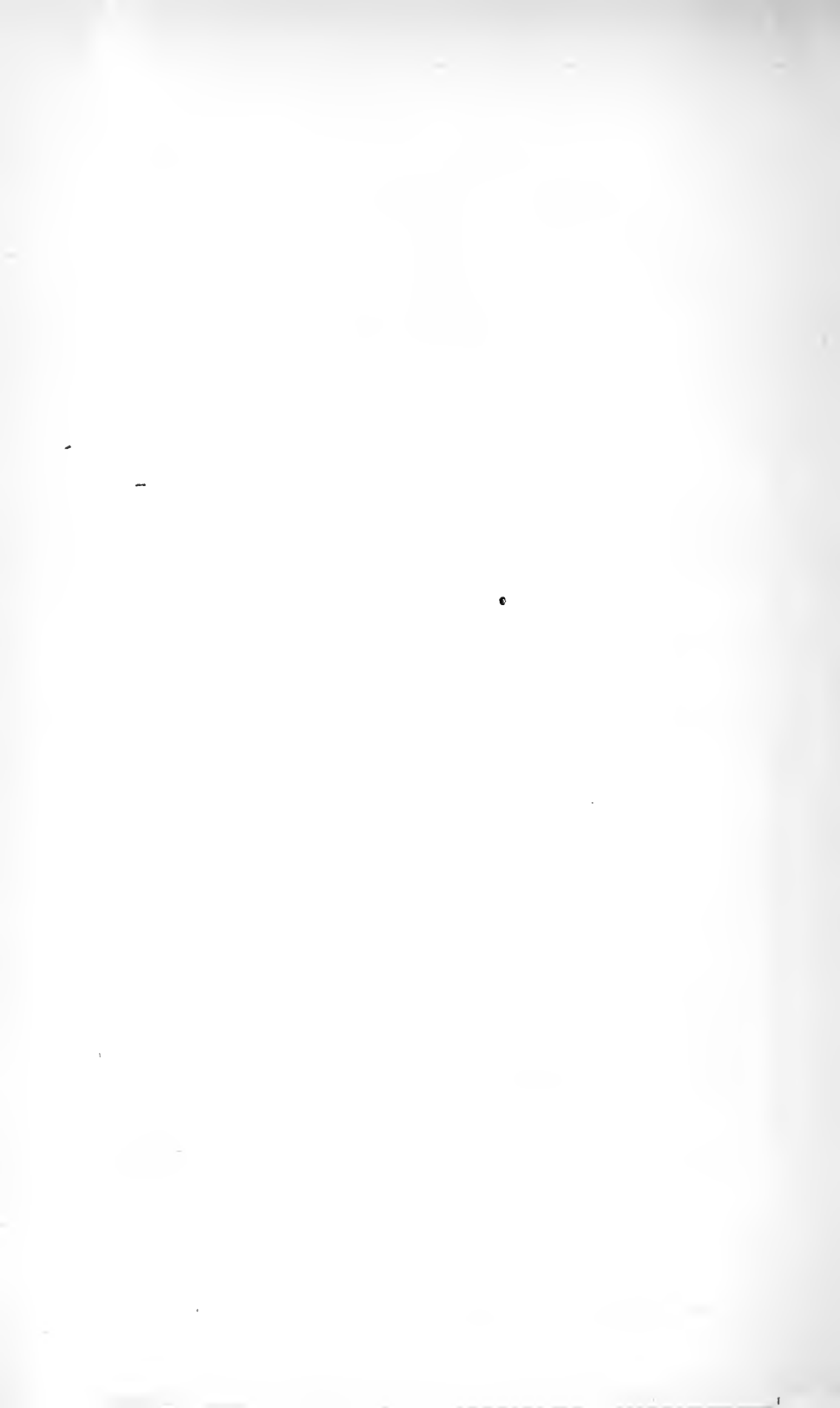


PLAN SHOWING SOME OF THE
UNDERGROUND STRUCTURES IN STATE STREET
AS RELOCATED ON ACCOUNT OF THE CONSTRUCTION OF THE
EAST BOSTON TUNNEL
DURING 1902-3

NOTE - Relocated structures shown by full lines
Underground

Scale of Feet 0 10 20 30 40 50 60 70 80 90 100





was prosecuted night and day, two shifts of workmen being employed. On the side walls about 120 men worked on each shift. On the roof the number was about 60 for each shift; on the core about 50 each.

Character of the Excavated Earth. — From India street to Merchants row the first 15 feet were of miscellaneous filled material and logs. Below this blue clay was the general rule, although some sandy clay was encountered. Westerly from Merchants row, after about ten feet in depth of filled material, and some silt, the excavation was through variable material, — sometimes sand, sometimes gravel, sometimes clay.

SECTION E OF THE EAST BOSTON TUNNEL.

Contractors for Construction.

Side walls and sewers outside of the Old State House, Gow & Foss.

Building foundations for columns, erecting columns, and constructing roof of part of the Old State House Station, Harry P. Nawn.

Tunnel at the head of State street and making alterations and additions to the Old State House, Woodbury & Leighton.

Transit Commission Assistant Engineer. — Harry S. R. McCurdy.

	Date of contract.	Date of beginning work.	Time of completion named in contract.	Date of final certificate.
Side walls and sewers outside of the Old State House ... }	Sept. 5, 1902	Sept. 6, 1902	Dec. 15, 1902	Oct. 18, 1902
Building foundations for columns, erecting columns, and constructing roof of part of the Old State House Station }	Nov. 28, 1902	Nov. 30, 1902	Not precisely stated	May 4, 1903
Tunnel at the head of State street and making alterations and additions to the Old State House }	Jan. 3, 1903	Jan. 6, 1903	July 1, 1903	The work is still in process of construction

General Description. — This section includes the passenger station at the Old State House, and extends from about 37 feet east of Congress street to a point near the easterly side line of Washington street.

About 86 feet at the westerly end of the section is of the flat-arch type of tunnel used on a part of Section D. The general arrangement of the passenger station is that of the side platform type, with tracks between opposite plat-

forms. These platforms are about 227 feet long, of which 160 feet is straight, and vary in width from 10 to 20 feet on the north side to from 10 to 31 feet on the southerly side. A cross section is given on Plate 11 and a photograph on Plate 13.

To avoid interference with street traffic, and for other reasons, it was necessary to do the work piecemeal, and it was carried on in three contracts.

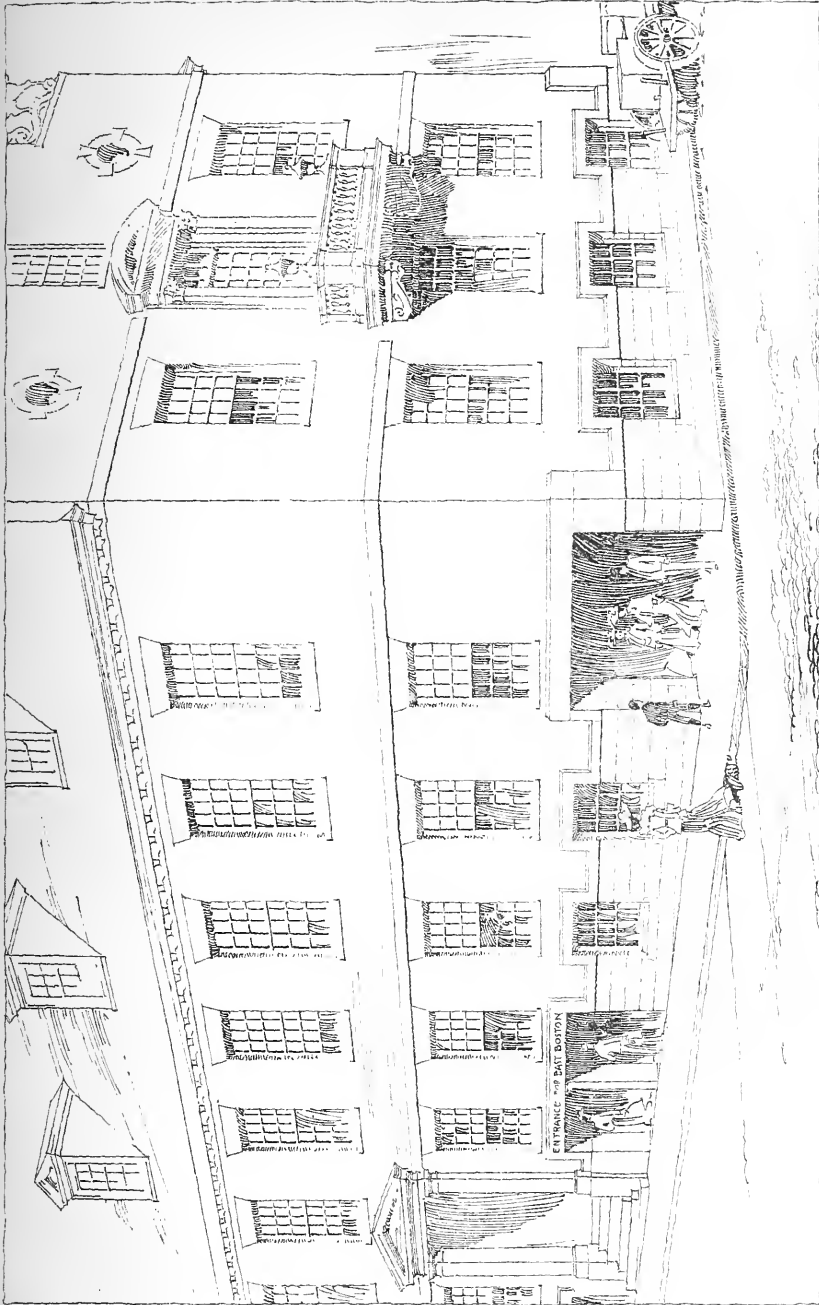
Side Walls and Sewers outside of the Old State House. — The side walls are constructed of concrete, 2 feet thick, and are reinforced with twisted steel rods placed vertically at intervals near the inside face of the wall. Outside of each of the walls and adjacent to it a sewer was constructed to take the place of the existing sewers, which occupied space required for the Tunnel.

After two test sections had been put in, work was begun on this section Sept. 6, 1902, under the contract of September 5 already mentioned. The excavation was mostly in gravel and clay, and the material was lifted to the street and deposited into carts by means of hoisting machines known as "inclines." They were placed close to the edgestones, and occupied a space only about 10 feet wide. The concrete was put in place mostly at night.

Building Foundations for Columns, Erecting Columns, and Constructing Part of Roof outside the Old State House. — The roof over the portion of the station under the street (Plate 13) was constructed of concrete arches upon steel girders. These girders are placed transversely to the line of the Tunnel 12 feet apart. They extend from side wall to side wall, and are supported at two intermediate points by steel columns resting on concrete footings.

A cross-section of the roof for pipe and duct crossings near Devonshire street and near Congress street was made relatively thin and flat and reinforced with I-beams or twisted steel rods. Some account of the relocation of pipes and ducts is given later in this report. Owing to the number and intricacy of these obstacles in the street, which had to be moved and maintained in service, the work on this contract was extremely tedious. The pipe crossings at Congress and Devonshire streets were built first, and the pipes and ducts laid across before proceeding with the rest of the work.

Tunnel at the Head of State Street and Alterations and Additions to the Old State House. — The easterly portion of the basement of the Old State House, about 31 feet wide, measured north and south, and 50 feet long, shown on Plates



SECTION E OF THE EAST BOSTON TUNNEL, -ALTERATIONS AT THE OLD STATE HOUSE,
SHOWING ENTRANCE TO THE STATION AND PASSAGEWAY AT STREET LEVEL
THROUGH EASTERLY END OF BUILDING. (LOOKING NORTHWESTERLY.)

HELIOTYPE CO., BOSTON.

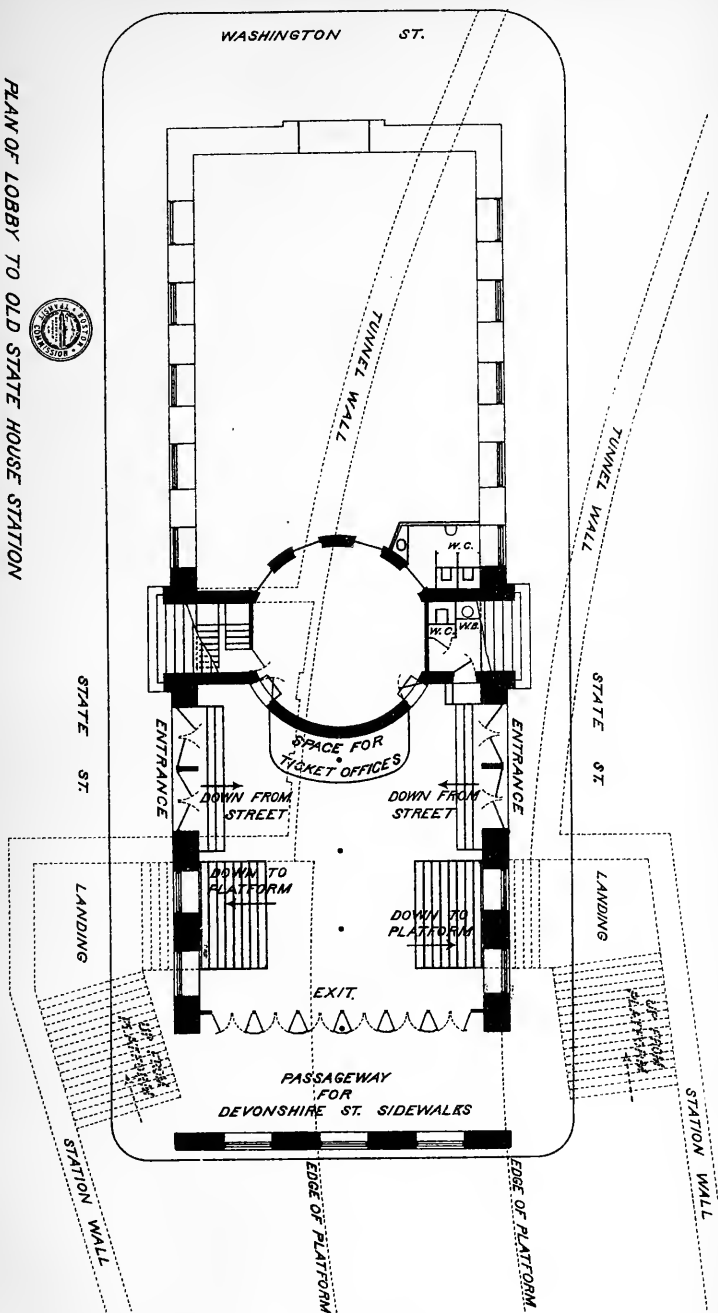


SECTION E OF THE EAST BOSTON TUNNEL,—PLATFORMS (UNFINISHED) OF THE OLD
STATE HOUSE STATION. (LOOKING EASTERLY.) JUNE 23, 1903.

PLAN OF LOBBY TO OLD STATE HOUSE STATION
EAST BOSTON TUNNEL

0 4 FT. 8 IN. 16 FT.
SCALE

W. G. M. Chief Engineer



12 and 14, will be used as a lobby for entrances, ticket offices, and exits from this station of the Tunnel. The entrances to the lobby will be from the northerly and southerly sidewalks of the Old State House and the exit will be into a so-called arcade, 11 feet wide, which will serve for a sidewalk of Devonshire street. A stairway of thirty-three steps will lead from the northerly side of the lobby to the west bound platform below, and a similar stairway will serve the east bound platform.

As the Tunnel passes under the Old State House, and part of the station lies beneath it, it was necessary to give new supports to a considerable part of the building. Concrete arches and girders reinforced with steel rods are used in part for this purpose. That under the easterly wall of the building is 3 feet thick and from 6 to 9 feet deep. The girder is supported at the ends upon the side walls and at two intermediate points by steel columns. Part of the southerly wall of the building has been extended down in concrete construction 3 feet thick. The northerly wall of the building rests upon the roof of the Tunnel. The floor of the room over the station lobby was raised about 19 inches and replaced with concrete and steel. Various changes were made in the doors and windows, but the original appearance of the building was changed as little as possible.

SECTION F OF THE EAST BOSTON TUNNEL.

A portion of the northerly side wall of the Tunnel, together with a piece of sewer, was built (Nov. 5, 1902, to Jan. 12, 1903) in Court street in front of the Ames Building. The wall constructed is about 112 feet long and extends from about opposite the westerly end of the building to a point near the middle of Washington street. The excavation at this point passed within 1 or 2 feet of and from 6 to 8 feet below the building foundations.¹ Owing to the great height and weight of the building, and the uncertain nature of the earth underneath and around it, the Commission decided to do the work at this point by day labor, under the direction of the Engineer. The excavation was through gravel and clay, and through sand containing some water. Trenches 16 feet long and 16 feet apart were dug to about the level of the bottom of the building foundation. Below the foundation one-half of each trench, or 8 feet in length was carried down to grade. The bank below the

¹The change of plans by which the Tunnel is connected at grade with the old Subway at Scollay square, instead of being carried underneath it (see pages 3 to 7), rendered these walls somewhat too deep. The lower portion will be left in and the walls will be added to on top as much as may be necessary.

foundation was held in place by means of concrete slabs (Plate 15) used as sheet piling. These slabs were from 6 to 8 feet long, 6 inches wide, and 2 inches thick, and each was reinforced with six square steel rods running the entire length of the slab. If wooden sheeting had been used, it would have been necessary either to have concreted directly against it and left it in place, or to have pulled the planks as the concrete was filled in. If the first method had been used, the planks would in time have become rotten, leaving a vacant space. If the planks had been pulled, there would have been danger that some of the earth under the building would run and a settlement of the building follow. In order to guard against any slight voids which might have been left in driving, grout was poured in behind the sheeting. This sheeting served not only to hold the bank in place, but was used, in place of a back wall, to waterproof against. The sheeting was not disturbed, and the wall of the Tunnel was built directly against it.

Bids will be opened July 7 for the construction of the Tunnel from the Old State House to the Winthrop statue. This contract will include a passenger station, with side platforms, in front of the Old Court House, and a stairway to connect the platforms with the platforms of the present Scollay-square station. Illustrations showing features of this station and adjacent Tunnel are given on Plates 16, 17 and 18. The time of completion mentioned in the contract is Dec. 20, 1903. The cars from East Boston will not be able to run into the Tremont-street subway until after the elevated trains are taken from said subway, and this cannot be done until the new tunnel near or in Washington street shall be built.

RELOCATION OF SEWERS, PIPES, ETC., IN STATE STREET.

Transit Commission Assistant Engineer. — Laurence B. Manley.

Location. — The work of relocation during the past year has been almost entirely confined to State street, between Chatham row and Washington street.

Structures Relocated. — The structures of the following city departments and private companies were relocated on account of the Tunnel construction :

- Street Department Sewer Division, sewers and catch-basins.
- Water Department, water-pipes.
- Boston Gas Light Co., gas-pipes.
- New England Telephone & Telegraph Co., conduits and steam heating pipes.
- Edison Electric Illuminating Co., conduits and tube lines.
- Boston Elevated Railway Co., conduits and poles.
- Western Union Telegraph Co., conduits.
- Postal Telegraph-Cable Co., conduits.
- Massachusetts Telegraph and Telephone Co., conduits.



SECTION F OF THE EAST BOSTON TUNNEL,—CONCRETE SHEETING PLANKS TO BE LEFT IN PLACE
IN SHORT SECTIONAL TRENCH BELOW FOUNDATION OF AMES BUILDING. THIS SHEETING
SERVES AS BACKWALL TO SIDEWALL OF TUNNEL AND WILL RECEIVE A COAT OF
PITCH FOR WATERPROOFING. (LOOKING NORTHWESTERLY.) DEC. 27, 1902.

CROSS SECTION STATION 72+00

YOUNGS HOTEL.

Sheet Piling
Pile Caps

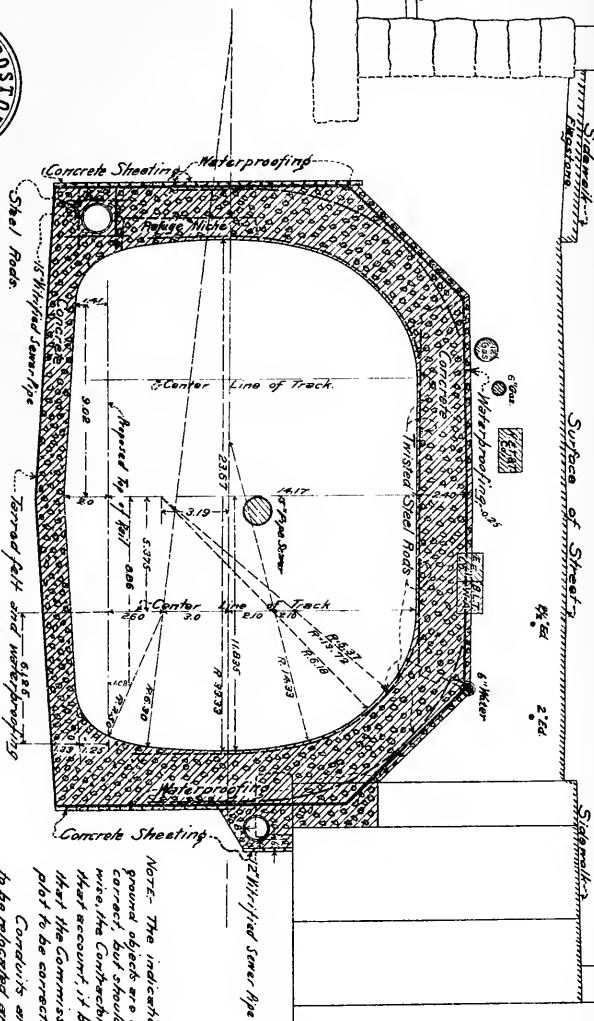
Surface of Sheet Piling

1/4" Sec 2 1/2" Sec

ROOMS BUILDING.

Top of Ceiling Floor

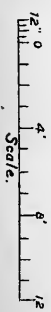
Top of
Basement Floor

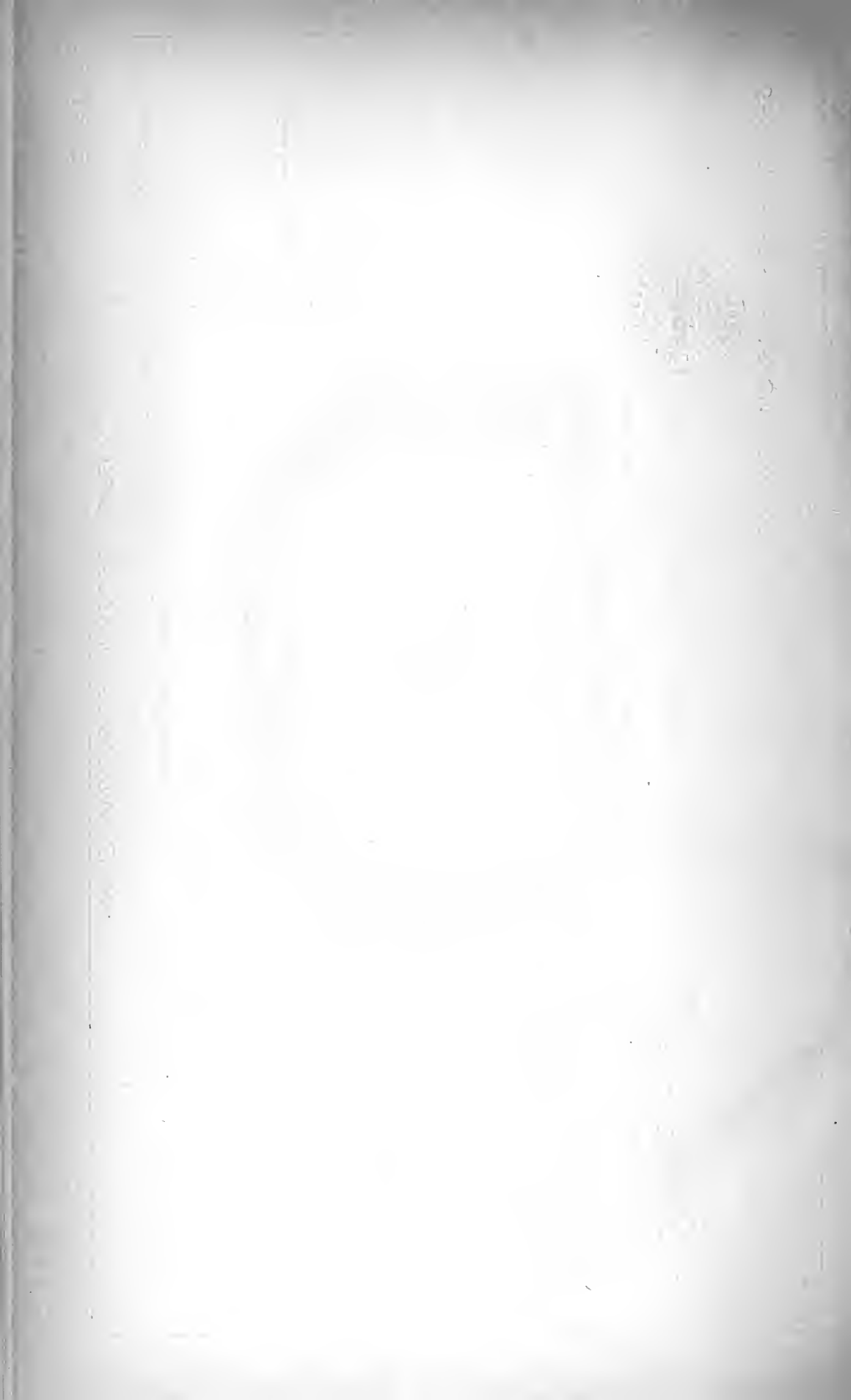


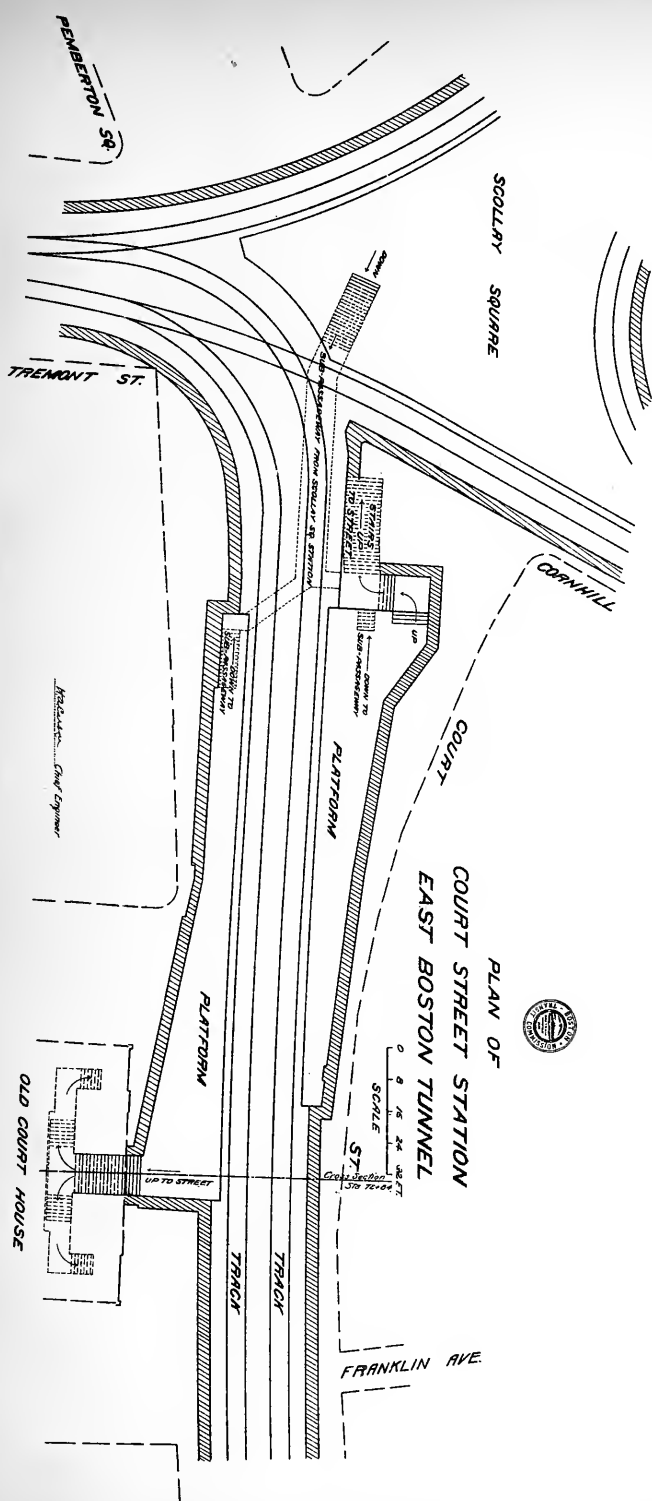
SECTION F EAST BOSTON TUNNEL

Drawn by Edgar G. G. 18 H. A. Cullen Chief Engineer
 Traced by Edgar G. G. 18
 Revised by Edgar G. G. 18

Elevation = 100







Low Tension Wire Association comprising :

Mutual District Messenger Co.,	}	Conduits.
Holmes Electric Protective Co.,		
Boston Electric Protective Association,		
Boston Automatic Fire Alarm Co.,		
Boston District Messenger Co.,		
United Telegram Co.,		
Postal Telegraph-Cable Co.,		
Stock Quotation Telegraph Co.,		
Mixer Brothers.		

Fire Department, signal system, cables.

Police Department, signal system, cables, and police signal box.

The condition which obtained below the surface of State street at Congress and Devonshire streets prior to the construction of the East Boston Tunnel is shown in part by a plan published in the report of this Commission for 1902. The sewers, water-pipes, gas-pipes and electric conduits occupied the greater part of the available space between curbs to a depth of 12 feet, and between Merchants row and the Old State House they all lay for some portion of their length in the way of the proposed Tunnel. All of the principal companies and city departments using electric conduits in Boston were represented in State street, and the number of wires below ground between Devonshire and Congress streets was such that if they were strung separately on cross arms of the maximum size a pole line 675 feet high, or more than three and one-half times the height of the Ames building, would be required to carry them.

General Arrangement. — East of Merchants row, the Edison tubes, the gas-pipes, the conduits of the telephone companies, and various manholes were relaid after construction of the Tunnel in their old locations. The old sewer was replaced by two deeper sewers on the side walls. West of the same point everything was removed and relocated in a more compact and orderly manner. The general form of the new arrangement is shown by the cross section on Plate 11. A 3 feet 3 inches \times 2 feet 2 inches concrete sewer and a pipe sewer decreasing from 20 inches to 12 inches in diameter were built just outside of the south and north side walls respectively and at the same time with the walls. Over these were placed the duct lines of vitrified clay surrounded by concrete: about 57 ducts for low tension wires on the south side and 12 ducts for high tension electric light wires on the north side. Each company insisted on separate manholes, and considerable ingenuity had to be exercised in arranging the manholes so that each conduit might swing out of the main duct line into its own manhole and also

connect with existing lines in cross streets. The manholes as built have no foreign pipe passing through them and are much more capacious than formerly. A few covers are unavoidably placed in crosswalks and sidewalks.

The water and gas pipes (the former on brackets) are laid on the sloping sides of the north side wall and the Edison tubes are placed on the roof.

The new structures are satisfactory to their owners and to the Wire Department, are arranged in a more compact and orderly manner than before, and have an increased capacity of about 50 per cent. Plate 11 shows the present location of the relocated structures between Kilby and Washington streets. The cost of relocating the sewers and water-pipes and the cost of the new cables used for the fire alarm and police signal systems was borne by the Commission. The cost of all other relocation was borne by the various companies interested.

Method of Construction. — The relocation of the underground objects was ordered by votes of the Commission on Aug. 28 and Sept. 4, 1902; work was commenced at once, was continued through every day and night for the greater part of the year, and is now substantially completed. On every working day from 7 A.M. to 7 P.M. State street has been open to traffic and the service in all pipes and conduits except a portion of the gas-pipes has been practically continuous and uninterrupted.

To accomplish this result, various and unavoidably expensive expedients have been resorted to. Much work has been done on nights and Sundays and the greater part of the relocations have been made beneath the temporary wooden street surface. To maintain service it was necessary to leave the old structures in place until the new structures could be built, and at one time both of these, together with the Tunnel roof, occupied the space which formerly appeared to be completely filled by the original pipes and conduits. All relocations were made under the direction of the Transit Commission, whose engineers gave lines and grades and prescribed the order in which the work should be done, and in this connection it is but just to acknowledge here the hearty coöperation of contractors and companies and the cheerful and prompt response made by them at all times to the suggestions of the Commission.

Sewers. — On account of the back sewage which stood under a head at high tide in the old sewers at the lower part of State street, it was not practicable to connect build-

ings with them until the new sewers were finished as far as the west end of the Exchange building. Until this was done the old wooden sewer in the middle of the street remained in service, and house connections were maintained into it through holes left where necessary in the Tunnel side walls. Much inconvenience and expense was suffered from the old sewer, alluded to elsewhere, which continually broke out at high tides and several times flooded the trenches and the shaft at McKinley square.

Catch-Basins. — The catch-basins were rebuilt after the Tunnel was completed and back filled.

Water-Pipes. — The new water-pipes were set in place by the Tunnel contractors, and a small force of men from the Water Department made the joints. The new 16-inch low-service main was practically completed, partly on the side walls and partly in advance of the Tunnel construction, before the service in the old main was discontinued. On Sunday, November 30, all service pipes and connections at intersecting streets from Merchants row to Devonshire street were shifted from the old to the new mains and water was turned on to the new lines before 7 A.M. of Monday morning. The change from the old 8-inch to the new 12-inch high-service main was made in six operations, and the increased cost due to the enlarged size was borne by the Water Department. The house services of the Atlantic Bank, the Exchange building, and the Brazer building as relocated entered the buildings at new places, and the inside work made necessary was done by the owners of the buildings at the expense of the Commission. The service and fire pipe of the Exchange building were shifted from State street to Kilby street to avoid a shallow crossing over the Tunnel roof where freezing was possible. For the same reason a 12-inch low-service main was laid through Congress square and State street on the south side of the Old State House, which fed the mains in Congress and Devonshire streets and avoided the necessity for shallow crossings over the Tunnel roof at these streets. The complication of the pipe-laying is illustrated by the fact that twelve per cent. of the entire length of the water mains as relocated is made up of special castings. From the shaft at the Custom House to the Old State House the water-pipes have been solidly supported by piers built from the Tunnel roof, and the greatest care has been exercised to provide against future accidents due to settlement. All of the work has been done under the inspection and to the satisfaction of the Water Department.

Conduits. — The conduits were relocated by the fourteen private companies interested, who, realizing their community of interest, made contracts with the firm of Gow and Foss, Tunnel Contractors, to build all of the main conduits and manholes, thus avoiding much confusion. The relocation of house services and all cable work was done directly by the several companies. The solid system of the Edison Electric Illuminating Company was shifted from time to time to make room for the Tunnel and various other structures, and was finally relaid in a more orderly manner on the completed Tunnel roof. In many cases the old, low-tension cables were stripped of their conduits to allow room for new work, and were hung from the bridge timbers until they could be replaced by others in the new ducts. For the same reason, some high tension electric light and power cables were carried temporarily in iron pipes. The new manholes were generally left uncompleted until the old structures could be relieved from service and removed. As an example of the difficulties encountered, a single case, that of the relocation of a conduit 90 feet long at Devonshire street, owned jointly by the Edison Electric Illuminating Company and the Boston Elevated Railway Company, may be cited. Here it was necessary to partially rebuild the new conduits, manholes, and house services of thirteen companies,— and to remove their old cables, to remove two water-pipes and three gas-pipes, and to lay two lines of temporary conduits before a space could be cleared in which to build the Tunnel at this point. After the Tunnel was finished, the permanent ducts were laid, and the cables finally relocated. This occupied all of the time from Nov. 15, 1902, to March 26, 1903, and was a serious delay to the work.

Gas-Pipes. — The gas-pipes were generally removed by the Boston Gas Light Company as fast as Tunnel excavations were made, and were replaced by larger pipes after the completion of the Tunnel roof. As little gas is used on State street, a few small temporary pipes sufficed to supply the demand of the company's customers. Service was maintained, however, through the winter in the 12-inch and 18-inch mains crossing at Congress and Devonshire streets.

Police Signal and Fire Alarm Cables. — These cables were stripped and hung up out of the way during the construction of the Tunnel, and new cables furnished by the Commission were finally drawn into the ducts of the New England Telephone and Telegraph Company.

Accidents. — Since ground was broken on Sections D and E, the water and gas pipes have been under constant sur-

veillance, and for the greater part of the time the cables have been regularly inspected by their owners. During this time, aside from a few breaks in the water service pipes which did no damage, there have been no accidents to person or property due to the work of relocation.

NEW TUNNEL AND SUBWAY.

Plate 1 shows studies for the additional Subway and Tunnel provided for in the legislative statutes of 1902 and also shows the old Subway and part of the East Boston Tunnel and Elevated Road. The new Tunnel and Subway has been discussed on pages 10 to 16 of the Commission's report, and additional discussion by the Engineer at the present time does not seem to be necessary.

Respectfully submitted,

H. A. CARSON,
Chief Engineer.



APPENDIX A.

INSTRUMENT OF TAKING OF AN EASEMENT UNDER LONG WHARF.

(*Suffolk Registry of Deeds, Lib. 2874, Fol. 212.*)

Whereas, George G. Crocker, Charles H. Dalton, Thomas J. Gargan, George F. Swain and Horace G. Allen constitute the Boston Transit Commission, and said Commission at a regular meeting held this sixth day of January, 1903, at which meeting a quorum was present, by vote adopted the following motion:

“The Boston Transit Commission deems that it is necessary for purposes set forth in section 17 of chapter 500 of the acts of the Legislature of the Commonwealth of Massachusetts for the year 1897 being ‘An Act to Promote Rapid Transit in the City of Boston and Vicinity,’ as amended by chapter 114 of the acts of the year 1902 being ‘An Act Relative to the Connecting of the East Boston Tunnel, the Cambridge Street Subway, and Other Subways,’ to take in fee an easement or right to construct, maintain, and operate a tunnel in and through a portion or section of certain real estate lying easterly of Atlantic avenue in the City of Boston in said Commonwealth, known as ‘Long Wharf’ and supposed to belong in whole or in part to ‘The Proprietors of the Boston Pier or Long Wharf,’ a corporation organized under the laws of said Commonwealth. The location, width and height of such portion or section are indicated on a plan entitled ‘Plan and Vertical Section of Long Wharf Showing Easement Taking for a Portion of the East Boston Tunnel,’ said plan being dated January sixth, 1903, being signed by a majority of the Commission and by H. A. Carson, the chief engineer of the Commission, and being numbered 5689.

“The portion or section in and through which it is necessary to take such easement or right as aforesaid is described as follows: It is below the surface of the soil and is included within vertical sides and horizontal planes as hereinafter defined.

“One vertical side is southerly and the other northerly of a line described as follows:

“Said line begins at a point on the easterly side of Atlantic avenue which point is distant one hundred and four and one-one hundredths (104.01) feet southeasterly of the northwesterly corner of State street and Atlantic avenue and one hundred and nineteen and seventy five-one hundredths (119.75) feet northeasterly of the southwest corner of said street and avenue and from said point said line runs in a northeasterly direction at an angle of seventy-nine degrees, twenty minutes, ten seconds, (79° 20' 10'') with the easterly side of Atlantic avenue three hundred and fifteen (315) feet and thence runs still in a northeasterly direction curving northerly upon a curve with a radius of two thousand (2,000) feet to the Harbor Commissioners' line.

"Starting from Atlantic avenue and running northeasterly, the southerly vertical side is parallel to said line and is fourteen and nine-tenths (14.9) feet distant therefrom measured at right angles thereto and continues at said distance therefrom for the distance of two hundred and thirty-nine and five-tenths (239.5) feet measured along said line. From this point the southerly vertical side changing direction is continued straight, converging towards said line until at the distance of one hundred and fifty-one (151) feet measured along said line it reaches a point which is thirteen and six-tenths (13.6) feet distant from said line measured at right angles thereto and from said point said southerly vertical side continues parallel to said line to the Harbor Commissioners' line.

"Starting from Atlantic avenue and running northeasterly the northerly vertical side is parallel to said line described as above and is fourteen and nine-tenths (14.9) feet distant therefrom measured at right angles thereto and continues at said distance therefrom for the distance of two hundred and thirty-nine and five tenths (239.5) feet measured along said line. From this point the northerly vertical side changing direction is continued straight diverging from said line until at the distance of one hundred and fifty-one (151) feet measured along said line it reaches a point which is sixteen and two-tenths (16.2) feet distant from said line measured at right angles thereto and from said point said northerly vertical side continues parallel to said line to the Harbor Commissioners' line.

"The horizontal planes within which such portion or section is included or confined are described as follows:

"The upper horizontal planes, beginning at the easterly side of Atlantic avenue, are as follows: The first plane is at a depth of twenty-one (21) feet below Boston city base, and continues for a distance of two hundred (200) feet measured along said line described as above; the second plane, next easterly of said first plane, is twenty-six (26) feet below said city base and continues for the distance of two hundred (200) feet measured along said line; the third plane, next easterly of said second plane, is thirty-one (31) feet below said city base and continues for the distance of two hundred (200) feet measured along said line; and the fourth plane, next easterly of said third plane, is thirty-six (36) feet below said city base, and continues for the distance of two hundred and sixty-three (263) feet measured along said line to the Harbor Commissioners' line.

"The lower horizontal planes between which and said upper horizontal planes the portion or section above described is included or confined are parallel to, co-terminous with and respectively thirty-six (36) feet below said upper horizontal planes. The westerly end of each horizontal plane is vertically below the easterly end of the next preceding horizontal plane as above described.

"Wherefore, Said easement or right is hereby taken in fee for the City of Boston in part execution of the authority conferred and of the duties imposed upon the Boston Transit Commission by said chapter 500 of the acts of the year 1897, by said chapter 114 of the acts of the year 1902, by the acts in amendment thereof and in addition to said acts and of every other power and authority said Boston Transit Commission hereto enabling."

Now, therefore, the Boston Transit Commission in accordance with the foregoing vote and pursuant to the acts therein referred to hereby certifies and states that under and by virtue of the authority conferred

by said acts, and in part execution thereof, and for the purposes therein set forth, and by virtue of every other power and authority it hereto enabling, the easement or right to construct, maintain and operate a tunnel in and through the portion or section of real estate above described is taken by it in fee simple for the City of Boston.

In witness whereof we, the undersigned, constituting a majority of the Boston Transit Commission hereto set our hands this sixth day of January in the year nineteen hundred and three.

(Signed)

GEORGE G. CROCKER,	} <i>Boston Transit Commission.</i>
C. H. DALTON,	
GEO. F. SWAIN,	
HORACE G. ALLEN,	

APPENDIX B.

AN ACT TO AUTHORIZE THE CITY OF BOSTON TO PROVIDE FUNDS FOR THE CONSTRUCTION OF THE EAST BOSTON TUNNEL.

[Stat. 1903, Chap. 190.]

Be it enacted, etc.

SECTION 1. The treasurer of the city of Boston shall from time to time, at the request of the Boston transit commission, issue and sell at public or private sale bonds of said city in excess of the issues heretofore authorized to an amount not exceeding three hundred thousand dollars. Such bonds shall be designated on their face, Rapid Transit Loan, shall be for the term of forty years, shall be registered or with coupons attached, and shall bear interest at a rate not exceeding four per cent per annum, payable semi-annually, as said treasurer shall determine, and shall not be included in determining the legal limit of indebtedness of the city. Said treasurer shall apply the proceeds of said bonds to the payment of the cost and expenses of constructing the tunnel or tunnels to East Boston, as authorized by chapter five hundred of the acts of the year eighteen hundred and ninety-seven and acts in amendment thereof and in addition thereto; and as required by said act shall keep a separate account of the bonds issued and of the cost and expenses incurred in the construction of said tunnel or tunnels.

SECTION 2. This act shall take effect upon its passage. [*Approved March 31, 1903.*]

APPENDIX C.

CONTRACT BETWEEN THE CITY OF BOSTON AND THE
BOSTON ELEVATED RAILWAY COMPANY FOR THE USE
OF THE NEW TUNNEL AND SUBWAY.

[The form of contract prepared and approved by the Commission did not, in all its parts, meet with the approval of the company. As the Commission and the company could not agree upon it, the company, under section 10 of the act, applied to the Board of Railroad Commissioners to determine its provisions. The following is a copy of the contract in the form determined by the Board and thereupon executed by the Commission. Where changes were made by the Board, the form which the Commission approved of is shown in italics in the column at the left of the page.]

This contract made this twenty-fifth day of September in the year one thousand nine hundred and two by and between the city of Boston, hereinafter called the city, acting by the Boston Transit Commission, hereinafter called the commission, under and by virtue of an act of the Commonwealth of Massachusetts entitled "An Act to Provide for the Construction of Additional Tunnels and Subways in the City of Boston," being chapter 534 of the acts of the year one thousand nine hundred and two, hereinafter called the act, and the Boston Elevated Railway Company, hereinafter called the company, witnesseth as follows:

The city, pursuant to the act and in consideration of the rental therein provided for, hereby contracts with the company for the sole and exclusive use of the system of tunnels, subways and appurtenances which may be constructed under the authority of the act, which system and appurtenances are hereinafter called the premises.

The term is for the period of twenty-five years from the Term. beginning of the use of the tunnel, as said use and tunnel are in the act defined.

The rental is an annual rental equal to four and one-half Rental. per cent. of the net cost of the tunnel and subway respectively. The net cost of the tunnel and subway respectively shall be deemed to include all expenditures incurred in acquisition and construction, including damages, expenses and salaries of the commission and interest at three and one-fourth per cent. per annum on the debt incurred in construction prior to the beginning of the use of such tunnel or subway respectively. Such net cost shall also include the amount expended for preliminary investigations and otherwise under the provisions of section two of the act, and the amount expended for alterations in the existing subway and in the approaches thereto under the provisions of section twelve, and shall be reduced by the deductions provided for in section seven, and if affected by any other provisions of the act shall be computed in accord-

ance therewith. The rental shall be paid to the city in quarterly payments on the last day of December, March, June and September in each year and at the rate aforesaid for any uncompleted quarter of a year. The rental of the tunnel and subway respectively is to begin when the use of each begins as hereinafter defined.

If at any time during the continuance of the term of this contract the company shall be deprived in whole or in part of the use of the premises by any cause growing out of the act of God, public enemies, mobs, riots, bursting of water-pipes outside the premises, excavations carried on by the city or other public authority, or by the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises, then the rental or a just and reasonable part thereof, as agreed upon by the mayor of the city and the company or in case of difference as determined by arbitration as hereinafter provided, shall be suspended or abated during such deprivation.

If at any time during the continuance of the term of this contract the company shall be deprived in whole or in part of the use of the premises by any cause growing out of the act of God, of public enemies, of mobs or of riots; or growing out of works or excavations carried on or permitted by the city or other public authority; or growing out of explosions or the bursting of pipes outside the premises, the falling or settling of buildings, the filling or caving in or other physical obstruction of the premises or any part thereof not due to any act of the company, or its agents, servants or licensees, in the use of the premises, or to any negligence on its or their part, or to any failure of the company to maintain the premises in good order and condition as herein provided; or growing out of the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises; then the rental or a just and reasonable part thereof, as agreed upon by the mayor of the city and the company or in case of difference as determined by arbitration as hereinafter provided, shall be suspended or abated during such deprivation.

Use.

The use is the sole and exclusive use of the premises for the running of trains and cars therein and such other uses as are hereinafter specified.

The use of the tunnel or subway respectively shall begin when in the opinion of the commission a reasonable time after completion has been allowed for equipment.

The use of the premises is to be upon the following provisions and conditions.

Provisions and conditions.

Equipment of the premises.

The company shall suitably lay and maintain in first-class condition railway tracks in proper places in the premises, together with the appointments and apparatus necessary for the safe and convenient operation of the same and shall provide and maintain all wires, electrical or other apparatus or equipment necessary or convenient for the furnishing of power and light therein and shall further provide requisite pumps, fans and ventilating apparatus and in general shall completely equip and furnish the premises with all machinery, piping, apparatus and furniture proper and adapted thereto and neces-

sary for the convenient maintenance and operation of a railway therein and for the safety and accommodation of the passengers upon such railway.

All tracks, wires, appliances, fixtures, machinery, equipment, furniture and apparatus provided by the company shall be and remain the property of the company so long as it continues to occupy and use the premises under the provisions of this contract, and upon the termination of such use the city hereby agrees to take and pay for all such property at its then fair value as agreed upon by the mayor of the city and the company or in case of difference as determined by arbitration as hereinafter provided, and the company agrees to deliver to the city all such property at such valuation.

The company shall maintain the premises, except as to repairs below excepted, in good order and condition as a complete structure adapted to the maintenance and use of lines of railway, and shall at all reasonable times be entitled to a permit to open the streets and other public grounds of the city for the purpose of making requisite repairs to the premises, and when the right of the company or its assigns to use the premises shall terminate shall restore them to the city in good condition except as to repairs not obligatory upon the company.

All repairs to the premises shall be at the sole cost and expense of the company except such repairs as are made necessary by the act of God, public enemies, mobs, riots, bursting of water pipes outside the premises, excavations carried on by the city or other public authority, or by the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises; and if repairs should be made necessary by any of said excepted causes then such repairs shall be made by the company and the reasonable cost and expense thereof deducted from the rental subsequently payable.

All repairs to the premises shall be at the sole cost and expense of the company except such repairs as are made necessary by any cause growing out of the act of God, of public enemies, of mobs or of riots; or growing out of works or excavations carried on or permitted by the city or other public authority; or growing out of explosions or the bursting of pipes outside the premises, the falling or settling of buildings, the filling or caving in or other physical obstruction of the premises or any part thereof not due to any act of the company, or its agents, servants or licensees, in the use of the premises, or to any negligence on its or their part, or to any failure of the company to maintain the premises in good order and condition as herein provided; or growing out of the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises; and if repairs should be made necessary by any of said excepted causes then such repairs shall be made by the company and the reasonable cost and expense thereof deducted from the rental subsequently payable.

The city shall not be responsible to the company for damages of any description resulting from any defects in the premises, whether structural or arising out of want of repair ^{Liability for damages.}

or from any cause after the use of the same by the company has begun as hereinbefore provided, unless such damage result from the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises; nor shall it be responsible for any damages resulting to persons or property in the operation and use of the premises, including all parts thereof, whether on property belonging to the city or upon property the fee of which belongs to other parties, and the company shall hold the city harmless and indemnified therefrom and shall at its own expense upon due notice from the city defend all suits and other proceedings of every description, whether at law or in equity, which may be brought against the city, its officers, servants or agents by reason of any liability arising out of the operation and use of any portion of the premises or of the railways, machinery and apparatus therein and accruing after the right to use such portion has begun as herein provided, and shall satisfy all final judgments of legal tribunals

rendered in such suits and proceedings; but the foregoing provisions shall not apply to legal proceedings to recover for loss or injuries growing out of the act of God, public enemies, mobs, riots, bursting of water pipes outside the premises, excavations carried on by the city or other public authority, or the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises.

rendered in such suits and proceedings. The foregoing provisions shall not be construed to impose any liability or obligation upon the company from any cause growing out of the act of God, of public enemies, of mobs or of riots; or growing out of works or excavations carried on or permitted by the city or other public authority; or growing out of explosions or the bursting of pipes outside the premises, the falling or settling of buildings, the filling or caving in or other physical obstruction of the premises or any part thereof not due to any act of the company, or its agents, servants or licensees, in the use of the premises, or to any negligence on its or their part, or to any failure of the company to maintain the premises in good order and condition as herein provided; or growing out of the location, maintenance or use of the wires or other apparatus which the city is hereinafter authorized to maintain in the premises.

Premises to be kept clean.

The company shall keep the premises thoroughly clean and free from unnecessary dampness, and the approaches to stations clean and free from ice and snow. When the premises are in use it shall suitably light the same in all parts, and by means of artificial ventilation shall keep the air adequately pure for health and comfort.

Inspection by public officials.

The governor of the commonwealth, the mayor and engineer of the city, and the members of the board of Railroad Commissioners, hereinafter called the board, and of the commission, and their respective engineers shall at all times have free entry to the premises for the purpose of inspecting the same.

Changes in premises.

The company within the limitations of the act may make such alterations in or additions to the premises as may be approved by the commission.

To the extent of the power of the company so to do and the power of the commission to contract therefor, the company may place and maintain in the premises booths for the sale of newspapers, magazines, periodicals and books, and in places specially adapted therefor may place or admit unobjectionable advertisements, and may make such other uses of the premises, not impairing the use for transportation of passengers, as the board may from time to time approve; provided however that such booths and advertisements shall not be so placed or used as to diminish or impair the safety, accommodation, convenience or comfort of passengers using the premises; and the company agrees that upon receipt of notice in writing at any time or from time to time from the board that in its opinion any of the uses above referred to or approved, either in whole or in part, in any way diminish or impair such safety, accommodation, convenience or comfort or conflict in any way with the best interests of the public, it will forthwith to the extent specified in the notice discontinue such use.

Additional
uses.

Newspaper
booths and
advertisements.

The company, upon such terms as it may deem expedient, may permit any person or corporation not authorized to carry on a railway business but authorized to use and maintain wires, conduits, tubes or similar structures along the route of the premises, to place such wires, conduits, tubes or similar structures within a corresponding portion of the premises used by the company, but only to such extent and for such time as may be practicable without interfering with the safe and convenient operation of the railway and other apparatus which the company is hereby authorized to put therein, but the privilege shall not extend to gas or water pipes.

Wires, con-
duits, and
tubes.

The city may place in the premises such wires and apparatus as may be necessary for its police and fire-alarm service, to be used however exclusively for such service and to be so located as not to interfere with the use of the premises which the company is hereby authorized to make. The location, construction, maintenance and repair of such wires and apparatus shall be subject to such reasonable directions and regulations as the company may impose or in case of any disagreement as the board may determine.

Except as above provided the company shall not have the right to place in the premises or attach thereto any structures, machinery, merchandise, apparatus, advertisements or property of any sort which are not necessary or proper for the operation of its railway therein and the performance of its agreements herein contained.

In the event of the failure of the company or its assigns to pay the rental for three months after such rental shall have become due, or in the event of a failure to maintain and operate a railway within the premises, and if such failure shall have continued for three months, then in either of said events the city upon three months' notice, such default still continuing, shall have the right to terminate this contract and to re-enter upon and repossess itself of the premises, unless such failure to maintain and operate grows out of the act of God,

Default and
penalty.

public enemies, mobs, riots, bursting of water pipes outside the premises, excavations carried on by the city or other public authority, or the location, maintenance or use of the wires or other apparatus which the city is herein authorized to maintain in the premises.

of public enemies, of mobs or of riots; or grows out of works or excavations carried on or permitted by the city or other public authority; or grows out of explosions or the bursting of pipes outside the premises, the falling or settling of buildings, the filling or

caving in or other physical obstruction of the premises or any part thereof not due to any act of the company, or its agents, servants or licensees, in the use of the premises, or to any negligence on its or their part, or to any failure of the company to maintain the premises in good order and condition as herein provided; or grows out of the location, maintenance or use of the wires or other apparatus which the city is herein authorized to maintain in the premises..

In case the right of reëntry and repossession above given shall be exercised, all the tracks, wires, apparatus, equipment and other property in the nature of fixtures of the company or its assigns within the premises may be taken by the city and be paid for by it at a valuation to be determined as herein provided for the occasion when the same are to be surrendered by the company at the expiration of the term of this contract.

Removal
of property
by railway
company.

The company shall have no right at any time to remove from the premises any tracks, wires, apparatus, equipment or other property necessary to the use and maintenance of the premises and the operation of a railway therein, except for the purpose of repairs or renewal or for the substitution of equivalent structures, property, apparatus or equipment.

Arbi-
tration.

In case of disagreement between the city acting by its mayor and the company as to the amount due for rental, or as to the suspension or abatement thereof as herein provided, or as to the valuation of the property upon the termination of the use herein contracted for, the matter in dispute shall be left to the decision of three persons, one to be selected by the mayor of the city, one to be selected by the company and the third by the two thus chosen. The report of the arbitrators or the majority of them shall be binding upon the parties hereto.

Termina-
tion of the
existence
of the com-
mission.

In respect of all matters arising under this contract where provision is made for action by the commission or its approval and agreed that upon the termination of the existence of the commission the authority to take such action shall vest in the city, which shall have all the rights, powers and privileges and be subject to all the duties, restrictions and liabilities herein conferred or imposed upon the commission in respect thereof; such powers to be exercised by the mayor, city engineer and city treasurer in place of the commission or by such other officers as the city council may prescribe.

The com-
pany to
be subject
to law.

With respect to the equipment, use and operation of the railway to be located in the premises and transportation thereon, the company is to have all the powers and privileges and be subject to all the duties, liabilities, restrictions and provisions set forth in general and special laws which now are or hereafter may be in force applicable to it.

The recital of any provision of the act in the body of this contract shall not be deemed to convey any implication that any other provision thereof is not equally a part of the contract.

The following is a copy of the act, the provisions of which, in so far as they declare, define or establish the terms and

conditions for the construction, tenure, maintenance and operation of the tunnel, subway and appurtenances, are hereby embodied in and made part of this contract.

Chap. 534, Acts of 1902.

AN ACT TO PROVIDE FOR THE CONSTRUCTION OF ADDITIONAL TUNNELS AND SUBWAYS IN THE CITY OF BOSTON.

Be it enacted, etc., as follows :

SECTION 1. The Boston transit commission, hereinafter called the commission, may construct in the city of Boston, hereinafter called the city, a system of tunnels and subways so designed as to be adapted for the accommodation of two tracks especially for use by elevated cars or trains and two tracks especially for use by surface cars, from a point or points near the junction of Broadway and Washington street or within one thousand feet therefrom, through and under public streets, squares or places and public or private lands, between the existing subway and a line parallel with and seven hundred and fifty feet easterly from Washington street to the line of Court and State streets, and thence northerly by such route as may be deemed best, to a point or points in or near Adams square, Haymarket square or Causeway street, together with approaches, sidings, entrances, stations, elevators, inclines, connections and other structures, hereinafter called appurtenances, which shall also include connections either at grade or otherwise with the East Boston tunnel and the existing subway.

The structure for the two tracks especially adapted for elevated cars or trains, hereinafter called the tunnel, shall be begun immediately after the acceptance of this act by a majority of the voters of the city as hereinafter provided. The structure for the remaining two tracks, hereinafter called the subway, shall be begun at such time after the expiration of one year from the completion of the tunnel as the commission and the Boston Elevated Railway Company, hereinafter called the company, may agree upon, or, in case of difference, as the board of railroad commissioners, hereinafter called the board, shall determine that the public interests require. The structure or structures for all four tracks, with the appurtenances, or any part or parts thereof, may be begun at any time after the acceptance of this act by a majority of the voters of the city as hereinafter provided, if and so far as the commission deems it expedient and if the company by its board of directors consents thereto.

SECTION 2. The commission shall immediately after the passage of this act make such preliminary investigations, surveys and plans as it deems expedient, and to that end may enter upon any lands and place and maintain marks therein, and may make excavations, borings and do all other acts necessary for such investigations and surveys. The commission may expend such sums as it deems necessary therefor. The expenses incurred in making such preliminary investigations, surveys and plans shall be paid from the loan authorized by chapter five hundred and forty-eight of the acts of the year eighteen hundred and ninety-four and acts in addition thereto, but if construction is begun hereunder the amount so expended shall be transferred and charged to the cost of such construction.

SECTION 3. The commission shall not begin the work of construction until it has filed in the office of the city engineer a plan signed by the commission showing the location of that part of the work which it is about to construct. Any such plan so filed may be altered at any time by a new plan signed and filed in like manner.

SECTION 4. The commission may make contracts in the name of the city for the work herein authorized, but all contracts involving two thousand dollars or more in amount shall be in writing and signed by a majority of the commission; and no such contract shall be altered except by an instrument in writing signed by the contractor and a majority of the commission, and also by the sureties, if any, on the bond given by the contractor, for the completion of the original contract. No such contract or alteration of any such contract shall be valid or binding on the city unless executed in the manner aforesaid.

SECTION 5. All work done under this act under or near public streets and places shall be conducted, so far as practicable, in such manner as to leave such streets and places, or a reasonable part thereof, open for traffic between the hours of eight in the forenoon and six in the afternoon of each secular day except public holidays.

SECTION 6. The commission may for the purposes of this act use public ways and lands without compensation therefor, and may take for the city, by purchase or otherwise, lands in fee and easements, estates, and rights in land, including the right to go under the surface thereof or through or under buildings or parts of buildings thereon, and such takings in fee or otherwise may be made whether the lands taken or otherwise affected are held under or by title derived under eminent domain or otherwise. A taking under this section of an easement or other estate or right in a given parcel of real estate, whether such parcel consists of unimproved land or of land and buildings, may be confined to a portion or section of such parcel fixed by horizontal planes of division below or above or at the surface of the soil, and in such case no taking need be made of upper or lower portions or sections, except of such easements therein, if any, as the commission may deem necessary. The commission, to make any taking by right of eminent domain, shall cause to be recorded in the registry of deeds for the county of Suffolk a description of the lands, easements, estates or rights to be taken, as certain as is required in a common conveyance of land, with the statement that the same are taken under authority of this act, which description and statement shall be signed by the commission; and the lands, easements, estates or rights therein described shall upon such recording be taken for and shall vest in the city. The commission shall, so far as may be practicable, notify all known owners of such takings, but the validity thereof shall not be affected by want of such notice.

SECTION 7. The commission may sell or remove the buildings from any and all lands taken by it, and shall sell, if a sale be practicable, or if not shall lease, any lands, or rights or interests in land or other property so taken, or purchased for the purposes of this act, whenever the same shall in the opinion of the commission cease to be needed for such purposes. The proceeds of such sales, and the fair valuation of any such lands or other property no longer needed for such purposes but not actually sold, as agreed on by the commission

and the company, or in case of difference as determined by the board, shall be deducted from the cost of the tunnel or the subway, as the case may be, for the purpose of ascertaining the rental thereof.

SECTION 8. The commission shall determine and award the damages sustained by any person by reason of property taken or injured by the commission under authority of this act, except public ways or lands, and may agree with any person as to the amount to be paid as damages sustained by him for any property so taken or injured, which damages the city shall be liable to pay. If such person is dissatisfied with such award, or cannot agree with the commission upon his damages, the same may be determined by a jury in the superior court for the county of Suffolk, on petition therefor of such person or of the commission against the city, filed in the clerk's office within one year after such property is so taken or injured; and judgment shall be entered upon the determination of such jury and costs shall be taxed and execution issued in favor of the prevailing party as in civil cases. The members of the commission shall not be personally liable for any such damage.

SECTION 9. The commission may order the temporary removal or relocation of any surface tracks, and the temporary or permanent removal or relocation of any conduits, pipes, wires, poles or other property of any person or corporation, which it deems to interfere with the construction or operation of the tunnel or subway, and shall grant new locations for any such structures so removed or relocated. Such orders, to the extent specified therein, shall be deemed a revocation of the right or license to maintain such tracks, conduits, pipes, wires, poles or other property, and the owner of any such structures in public ways or lands shall comply with such orders without expense to the city. If such owner shall fail to comply with the order of the commission within a reasonable time, to be fixed in the order, the commission may discontinue and remove such tracks, conduits, pipes, wires, poles or other property, and may relocate the same, and the cost of such discontinuance, removal or relocation shall be repaid to the city by the owner. No such discontinuance, removal or relocation shall entitle the owner of the property thus affected to any damages on account thereof. Any such structures in or upon private lands may be removed and relocated by the commission, or if removed and relocated by the owner thereof the reasonable expense shall be repaid him by the commission. Any gas company may shut off the gas from any pipes affected by any acts done hereunder, when and so far as it may be necessary to avoid danger of escape or explosion of gas.

SECTION 10. The commission shall within ninety days after the passage of this act execute with the company, in the name of the city, the company consenting thereto, a contract in writing for the sole and exclusive use of the tunnel and subway and appurtenances for the period of twenty-five years from the beginning of the use of the tunnel, at an annual rental equal to four and one-half per cent of the net cost of the tunnel and subway, respectively, for the running of trains and cars therein, and for such other uses and upon such provisions and conditions, not affecting the term or rental, as the commission and the company may agree upon, or in case of difference, as the board may determine. The provisions of this act, in so far as they declare, define or establish the terms and conditions for the construction, tenure, maintenance and

operation of said tunnel, subway and appurtenances, shall be embodied in and made part of said contract. The use of the tunnel or subway respectively shall begin when, in the opinion of the commission, a reasonable time after completion has been allowed for equipment. The net cost of the tunnel and subway respectively shall be deemed to include all expenditures incurred in acquisition and construction, including damages, expenses and salaries of the commission, and interest at three and one-fourth per cent per annum on the debt incurred in construction prior to the beginning of the use. If the contract for the use of the tunnel and subway is executed as above provided the commission, upon the acceptance of this act by the voters of the city as hereinafter provided, shall proceed with the work of construction.

SECTION 11. If the company shall execute the contract hereinbefore provided for, the company may, before the completion of the tunnel, construct lines of elevated railway according to such plans as the board may approve, to be operated by electricity or by such other motive power except steam, as may be approved by the board in respect of the locations heretofore granted to the company, upon the following locations, which are hereby granted therefor, and may equip, maintain and operate engines, motors, trains and cars thereon, to wit: — (a) beginning at the southerly end or ends of the tunnel, thence upon and over any streets and public or private lands to the company's elevated structure now erected on or near Washington, Mott or Castle street; (b) beginning at the northerly end or ends of the tunnel, thence upon and over any streets, squares and public or private lands to the company's elevated structure now erected on or near Causeway street; and (c), such other locations as may in the opinion of the board be necessary or convenient to connect the tunnel with the elevated structures of the company. For the purposes of this act, including all equipment or other expenditure by the company thereby required or authorized, the company may issue such amounts of its stock or bonds, or of each, as may be necessary therefor, subject to all laws applicable to such issue; and it shall have all the rights and powers, and be subject to all the restrictions, liabilities and obligations conferred or imposed by sections eight, nine, eleven, twelve and fifteen of chapter five hundred and forty-eight of the acts of the year eighteen hundred and ninety-four, and sections seven, eight, nine and twenty-one of chapter five hundred of the acts of the year eighteen hundred and ninety-seven. The locations granted by this section in, upon or over public ways or lands shall be held by the company or its assigns so long as it or they have the use of the tunnel.

SECTION 12. Upon the completion of the tunnel and appurtenances and upon notification as hereinbefore provided, the company shall remove its elevated trains and cars from the existing subway; and thereupon any alterations therein or in the approaches thereto necessary to re-adapt it to the use of surface cars shall be made by the commission, and the expense thereof shall be deemed part of the cost of the tunnel. The tunnel during the term of the contract hereinbefore provided for shall be and be considered a part of the elevated railway operated by the company; and the board, subject to the provisions of the contract, shall have and exercise the same power and control over the same in all respects that are conferred upon the board as to the elevated structure by

chapter five hundred and forty-eight of the acts of the year eighteen hundred and ninety-four, chapter five hundred of the acts of the year eighteen hundred and ninety-seven and by other laws in addition thereto. The company, upon removal of its elevated trains from the existing subway, may discontinue the use of its elevated structures and locations connecting its elevated road therewith, and may sell any lands or other property acquired for the purposes of such connection, applying all proceeds thereof to proper corporate uses; and such discontinuance or sale shall not be deemed to impair the capital of the company.

SECTION 13. Upon the determination by the commission of any important question arising in the course of the work herein provided for, upon which the company has previously requested a hearing, except an award of or agreement upon damages as provided in section eight hereof, the company may within three days after notice of such determination apply to the board for a revision of the same, and thereupon the board may consider and finally determine such question.

SECTION 14. At any time after the expiration of one year from the completion of the subway the board may order such surface tracks, together with the poles and wires used for the operation of cars thereon, to be removed from any part of Washington street between Broadway and Adams square, except tracks crossing said street, as in its opinion have been rendered unnecessary by the construction of such subway. Such order of the board shall be deemed a revocation of all rights or locations to occupy for street railway purposes the street or part thereof included in the order; and surface tracks shall not thereafter be laid or maintained thereon. Nothing in this section contained shall be construed as affecting any existing power to revoke locations on said street or any part thereof as provided by law.

SECTION 15. The use and control of the subway, if acquired by the company, shall be subject to the rights, if any, which the West End Street Railway Company may have under the provisions of article two of its lease to the company, dated December ninth, eighteen hundred and ninety-seven, or otherwise.

SECTION 16. The treasurer of the city shall from time to time, on request of the commission, issue and sell at public or private sale, the bonds of the city, registered or with interest coupons attached, as he may deem best, to an amount not exceeding the cost of the tunnel and subway herein provided for. Such bonds shall be designated on their face, Boston Tunnel and Subway Loan, shall be for such terms, not exceeding fifty years, as the mayor and treasurer of said city may determine, and shall bear interest payable semi-annually at such rate not exceeding four per cent per annum, as the treasurer shall determine. The debts incurred by the city from time to time under the provisions of this act shall not be included in determining the limit of indebtedness of the city as established by law, and the proceeds of such bonds shall be used to meet all damages, costs and expenses incurred by the commission or the city in carrying out the provisions of this act. The board of commissioners of sinking funds shall establish a sinking fund for the payment of the bonds issued under this act. All premiums received from the sale thereof shall be paid into the sinking fund. All rents, tolls, percentages or other annual compensation received by the city for any use of

the tunnel or subway under this act, or for any use of any lands or rights taken under authority of this act, shall annually be used by the treasurer, — first, to meet the requirements of and any deficiency in the sinking fund, — second, to meet the interest on the bonds, and the surplus, if any, as a part of the general revenue of the city. The proceeds from any sale of lands or rights taken by purchase or otherwise under authority of this act shall be paid into the sinking fund, or shall be used for construction, as the commission may determine.

SECTION 17. The term of office of the commission is hereby extended to the first day of July in the year nineteen hundred and six. The provisions of section two of chapter three hundred and seventy-five of the acts of the year eighteen hundred and ninety-nine shall remain in force during said extended term. If the term of the commission, as hereby or as hereafter extended, expires before the completion of the work herein provided for, the city shall have all the rights, powers and privileges, and be subject to all the duties, restrictions and liabilities, hereby conferred or imposed upon the commission in respect thereof, such powers to be exercised by the mayor, city engineer and city treasurer in place of the commission, or by such other officers as the city council may prescribe. If this act is not accepted by a majority of the voters of the city, as hereinafter provided, the term of office of the commission shall be extended only to the first day of July in the year nineteen hundred and four. The members of the commission for the extended term provided for in this act shall be appointed by the governor and the mayor of the city in the manner provided in section twenty-three of chapter five hundred and forty-eight of the acts of the year eighteen hundred and ninety-four. Said appointments shall be for the term of two years.

SECTION 18. The supreme judicial court and the superior court, upon application of any party in interest, including the city or any ten taxable inhabitants thereof, may enforce or prevent violation of the provisions of this act by any appropriate process:

SECTION 19. If the contract for the use of the tunnel and subway is executed by the commission and the company as hereinbefore provided, this act shall be submitted for acceptance to the voters of the city at the next municipal election, and if accepted by a majority of those voting thereon at such election it shall thereupon take full effect. The city shall have, hold and enjoy in its private or proprietary capacity, for its own property, the existing subway, the East Boston tunnel, the Cambridge street subway and the tunnel and subway built under this act, and all rents, tolls, income and profits from all contracts heretofore or hereafter entered into for the use of said subways or tunnels or any part thereof, and the same shall never be taken by the Commonwealth except on payment of just compensation: *provided, however*, that so much of such rents, tolls, income and profits as may be necessary therefor shall be paid into the respective sinking funds for the redemption of said bonds and used for the payment of the interest thereon.

SECTION 20. For the purposes of the preliminary work authorized by section two hereof, the payment of the expense of the same, the extension of the term of office of the commission and its powers to the first day of July in the year nineteen hundred

and four, the appointment of the members thereof, and the execution of the contract provided for by section ten, and the submission of this act to the voters as hereinbefore provided, this act shall take effect upon its passage. [*Approved June 27, 1902.*]

In witness whereof the parties hereto set their hands and seals the day and year first above mentioned, the City of Boston executing this contract by the Boston Transit Commission, pursuant to a vote of the Commission, its members not being bound in their personal capacity, and the Boston Elevated Railway Company causing its name and corporate seal to be affixed to these presents by its president thereto duly authorized.

THE CITY OF BOSTON BY THE BOSTON
TRANSIT COMMISSION

GEORGE G. CROCKER,
CHARLES H. DALTON,
THOMAS J. GARGAN, (Seal.)
GEORGE F. SWAIN,
HORACE G. ALLEN.

THE BOSTON ELEVATED RAILWAY COMPANY

BY WILLIAM A. BANCROFT, (Seal.)

President.

BOSTON ELEVATED RAILWAY COMPANY,

SECRETARY'S OFFICE,

101 MILK ST., BOSTON, MASS., Sept. 24th, 1902.

At a special meeting of the Directors of the Boston Elevated Railway Company held this day the following vote was passed:

Voted: That the President be, and he hereby is, authorized to execute, in the name and behalf and under the seal of the company, on or before September 25th, a contract for the use of the tunnel and subway provided for by chapter 534 of the Acts of 1902, in such form as may be agreed upon by the company, represented by the Executive Committee, and the Boston Transit Commission, or as may be determined by the Board of Railroad Commissioners.

A true copy.

Attest:

(Signed)

JOHN T. BURNETT,

Secretary.

Boston, September 25, 1902.

The following was passed at a meeting of the Boston Transit Commission held September 25, 1902:

"Voted, That the contract in the form as determined by the Board of Railroad Commissioners, being Document No. 3905, be executed by the City of Boston acting by the Boston Transit Commission."

A true copy.

Attest:

(Signed)

B. LEIGHTON BEAL,

Secretary.

APPENDIX D.

EMPLOYEES IN THE ENGINEERING DEPARTMENT WHO HAVE WORKED
ONE MONTH OR MORE DURING THE YEAR ENDING JUNE 30, 1903.

(Arranged in Alphabetical Order.)

NAME.	INDICATION OF DUTIES.
AIKEN, ROY C.,	Inspection of concrete, etc., Section C.
BABBITT, JOHN V.,	Inspection of concrete, etc., Section B.
BALLOU, ROY H.,	Inspection of concrete, etc., Section E.
BATCHELDER, EMMA,	Stenographer.
BELL, DANIEL S.,	Assisting on line and grade work, Section C.
BELL, WILLIAM H.,	Assisting on line and grade work for pipe changes and inspection of concrete on Sections B and C.
BROWN, C. LEONARD,	Inspection of concrete, Section B.
BROWN, HENRY W.,	Inspection of concrete, Sections B and C.
BROWN, MOSES L.,	Inspection of concrete, Section B.
BURNS, JOHN J.,	Draughting, etc., in office.
CALLINAN, WILLIAM H.,	Inspection of concrete, Section B.
CARTER, ARTHUR B.,	Clerk to the Chief Engineer.
CROWLEY, ERNEST M.,	Draughting, blue printing, etc.
DAVIS, EDMUND S.,	Oversight of office and field work.
DAVIS, WILBUR W.,	Draughting, etc., Boston Tunnel and Subway.
DICKINSON, DANIEL H.,	Inspection of concrete, Section C.
EAGER, FRANK J.,	Inspection of concrete, Sections C and E.
EDWARDS, FREDERICK B.,	Assisting on plans and estimates for Boston Tunnel and Subway.
EMERSON, GEORGE D.,	Designs for structures, draughting, etc.
FANCY, CLIFFORD R.,	Assisting in line and grade work and inspection of concrete, etc., Section B.
FARWELL, ROBERT B.,	In charge of construction of Section D.
FINNERAN, THOMAS A.,	Inspection of concrete, etc., Sections B, D and E.
FLAWS, JAMES B.,	Draughting, blue printing, etc., in office and assisting on surveys for Boston Tunnel and Subway.
FLETCHER, FREDERICK W.,	} Inspection of concrete, Section B.
FORDHAM, WILLIAM W.,	
FOSS, JAMES F.,	
FRAME, JAMES T.,	
GLEN, JOHN M.,	Assisting on line and grade work for pipe changes.

HALL, JOHN H. M.,	Inspection of concrete, Section C, and assisting on line and grade work, Section E.
HANDRAHAN, CHARLES F.,	Inspection of concrete, Section B.
HOLMES, ALBERT J.,	Assisting in line and grade work, Section B.
HOLROYD, CLINTON,	Inspection of concrete, Sections B, C and D.
HOWE, LEONARD B.,	Draughting, etc.
JOHNSON, CHARLES C.,	Testing cement, Sections B, C, D and E.
JOYCE, ARTHUR E.,	Inspection of concrete, Sections D and E.
LEWIS, WILLIAM W.,	Designs for structures, draughting, etc.
LOVELAND, CHARLES P.,	Inspection of concrete, Sections B and C.
LUCY, ARTHUR E.,	Inspection of concrete, Section B.
MACINTYRE, DANIEL J.,	Assisting in line and grade work and inspection of concrete, Sections D and E.
MANLEY, LAURENCE B.,	In charge of pipe changes, etc., Sections B, C, D and E.
MASON, JOHN E.,	Inspection of concrete, Section B.
MCCURDY, HARRY S. R.,	In charge of construction of Section E.
MCDONALD, FRANCIS A.,	Assisting in testing cement, Sections B, C, D and E.
MONEIL, NORMAN C.,	Assisting in line and grade work for pipe changes.
MURPHY, FREDERICK F.,	Assisting in line and grade work, Section D, and inspection of concrete, Section C.
MURPHY, JEREMIAH L.,	Messenger.
O'BRIEN, PATRICK F.,	Assisting on plans and estimates for Boston Tunnel and Subway.
PALMER, JOHN E.,	In charge of construction of Sections B and C.
PARKER, ALFRED W.,	Inspection of steel work.
PERRY, LEON W.,	Assisting in line and grade work, Sections D and E.
RAFTUS, PETER J.,	Inspection of concrete, etc., Sections C and D.
RICE, EDMUND A.,	Draughting and assisting on surveys for Boston Tunnel and Subway.
ROWELL, WESLEY A.,	Inspection of concrete, Section B.
RYCROFT, CHARLES J.,	Inspection of concrete, Sections C and D.
STEARNS, GEORGE H.,	Designs for structures, draughting, etc.
STEARNS, RALPH H.,	Assisting in line and grade work, Section E.
STILES, FREDERIC W.,	Photography, checking bills, etc.
STREET, L. LEE,	In charge of line and grade work, Section C.
WELLINGTON, WILLIAM O.,	In charge of line and grade work, Section B.
WILBER, NATHAN B.,	Inspection of concrete, Sections B and C.

APPENDIX E.

SOME OF THE CONTRACTORS WHO HAVE DONE WORK FOR THE COMMISSION DURING THE YEAR ENDING JUNE 30, 1903.

NAME.	CONTRACT.
SIMPSON BROTHERS CORPORATION, 166 Devonshire St., Boston.	Cross-walk of artificial stone over Section A of the East Boston Tunnel in Maverick Sq., East Boston, including granite curb each side, wrought-iron pipe fence, etc. Sidewalks of concrete and expanded metal at the Pleasant-St. entrance to the Subway.
THE BOSTON TUNNEL CONSTRUCTION Co., 23 Lewis St., East Boston. Robert A. Shailer, <i>President</i> . Charles F. Taylor, <i>Treasurer</i> . Principal foremen: Michael Tallent; John Boyle; William McLaughlin; John Kane.	Section B of the East Boston Tunnel.
Gow & Foss, 8 Exchange Pl., Rm. 14, Boston. Principal foremen on Section C: A. E. Weaving; James King; William H. Olmstead. Principal Foremen on Section E: Louis T. C. Loring; James Grouk.	Beginning of Section C of the East Boston Tunnel. Pipe crossings at Congress and Devonshire Sts. and portion of side wall, etc., Section E of the East Boston Tunnel.
SHERBURNE & Co., 53 Oliver St., Boston.	Wheels and cars for Section C plant.
PATRICK MCGOVERN, 55 Maywood St., Roxbury, Mass. Charles R. Gow, <i>Superintendent on Section C</i> . Principal foremen on Section C: A. E. Weaving; Patrick Porter; A. I. Negus. Principal foremen on Section D: Patrick Porter; James King.	Completion of Section C of the East Boston Tunnel. Side walls and sewer and core and invert, Section D of the East Boston Tunnel.

HARRY P. NAWN,
82 Savin St., Roxbury, Mass.
Principal foremen:
Robert J. Eager; John C.
Nawn.

Roof of Section D.
Building foundations for columns, erecting columns and constructing roof of part of Old State House Station, Section E.

Furnishing and laying about 250 square yards of brick sidewalk on the easterly side of Tremont St., between Warrenton St. and Pleasant St. and on the westerly side of Shawmut Ave. between the same streets.

EASTERN BRIDGE & STRUCTURAL
Co.,
Worcester, Mass.

About 115 tons of steel for Old State House Station, Section E.
Two steel posts, Old State House Station, Section E.

WOODBURY & LEIGHTON,
166 Devonshire St., Boston.
Principal foremen:
George O'Brien; John Skuse.

Tunnel at the head of State St. and making alterations and additions to the Old State House, Section E.

G. W. & F. SMITH IRON CO.,
Gerard St., Roxbury, Mass.

About 25 tons of steel for alterations in east end of Old State House, Section E.

NEW ENGLAND STRUCTURAL CO.,
110 State St., Boston.

About 115 tons of steel, comprising posts, I-beams, and a girder for Section F of the East Boston Tunnel.

PATRICK J. HEALEY,
Hyde Park, Mass.

Borings for New Tunnel.

APPENDIX F.

SECTION B.

PROGRESS PER WEEK BY ARCHES FOR YEAR ENDING JUNE 30, 1903.

	Station of Forward End of Rib.	Progress during Week, Feet.		Station of Forward End of Rib.	Progress during Week, Feet.
1902.			1903.		
July 5.....	29 + 42.5	35	Jan. 3.....	40 + 37.5	57.5
" 12.....	29 + 92.5	50	" 10.....	40 + 50	12.5
" 19.....	30 + 22.5	30	" 17.....	41 + 07.5	57.5
" 26.....	30 + 67.5	45	" 24.....	41 + 65	57.5
Aug. 2.....	31 + 10	42.5	" 31.....	41 + 92.5	27.5
" 9.....	31 + 55	45	Feb. 7.....	42 + 45	52.5
" 16.....	32 + 00	45	" 14.....	42 + 97.5	52.5
" 23.....	32 + 27.5	27.5	" 21.....	43 + 37.5	40
" 30.....	32 + 60	32.5	" 28.....	43 + 87.5	50
Sept. 6.....	32 + 92.5	32.5	March 7.....	44 + 40	52.5
" 13.....	33 + 42.5	50	" 14.....	44 + 85	45
" 20.....	33 + 87.5	45	" 21.....	45 + 30	45
" 27.....	34 + 32.5	45	" 28.....	45 + 75	45
Oct. 4.....	34 + 72.5	40	April 4.....	46 + 17.5	42.5
" 11.....	35 + 12.5	40	" 11.....	46 + 62.5	45
" 18.....	35 + 52.5	40	" 18.....	47 + 07.5	45
" 25.....	35 + 97.5	45	" 25.....	47 + 52.5	45
Nov. 1.....	36 + 55	57.5	May 2.....	47 + 97.5	45
" 8.....	37 + 10	55	" 9.....	48 + 32.5	35
" 15.....	37 + 62.5	52.5	" 16.....	48 + 77.5	45
" 22.....	37 + 77.5	15	" 23.....	49 + 22.5	45
" 29.....	38 + 00	22.5	" 30.....	49 + 55	32.5
Dec. 6.....	38 + 47.5	47.5	June 6.....	49 + 85	30
" 13.....	38 + 85	37.5	" 13.....	50 + 17.5	32.5
" 20.....	39 + 40	55	" 20.....	50 + 57.5	40
" 27.....	39 + 80	40	" 27.....	50 + 92.5	35
			" 30.....	51 + 07.5	15

APPENDIX G.

SECTION C.

PROGRESS PER WEEK BY ARCHES FOR YEAR ENDING JUNE 30, 1903.

	Station of Forward End of Rib.	Progress during Week, Feet.
1902.		
Sept. 29.....	59 + 22.8	
Oct. 6.....	59 + 15.3	7.5
" 13.....	58 + 92.8	22.5
" 20.....	58 + 67.25	25.55
" 27.....	58 + 29.0	38.25
Nov. 3.....	57 + 96.5	32.5
" 10.....	57 + 96.5	00.0
" 17.....	57 + 96.5	00.0
" 24.....	57 + 96.5	00.0
Dec. 1.....	57 + 96.5	00.0
" 8.....	57 + 96.5	00.0
" 15.....	57 + 96.5	00.0
" 22.....	57 + 91.5	5.0
" 29.....	57 + 69.0	22.5
1903.		
Jan. 5.....	57 + 34.0	35
" 12.....	56 + 96.5	37.5
" 19.....	56 + 54.0	42.5
" 26.....	56 + 19.0	35
Feb. 2.....	55 + 86.5	32.5
" 9.....	55 + 64	22.5
" 16.....	55 + 17	47
" 23.....	54 + 75	42
March 2.....	54 + 25	50
" 9.....	53 + 77.5	47.5
" 16..... Station	53 + 65	12.5
" 23.....	53 + 65	00.0
" 30.....	53 + 60	5
April 6.....	53 + 42.5	17.5
" 13.....	53 + 27.5	15
" 20.....	53 + 0	27.5
" 27.....	52 + 70	30
May 4.....	52 + 45	25
" 11.....	52 + 45	00
" 18.....	52 + 45	00
" 25.....	52 + 45	00
June 1.....	52 + 45	00
" 8.....	52 + 37	8
" 15.....	52 + 27	10
" 22.....	52 + 22.5	4.5
" 26.....	52 + 17.5	5.0
Total between dates given above		705.3

Placing air-locks
in position.Taking out
core.

Wide arch of passenger station.

APPENDIX H.

ANALYSIS BY PROFESSOR HENRY CARMICHAEL, NOVEMBER 29, 1902,
OF SAMPLES OF WATER FROM SECTION B OF THE EAST BOSTON
TUNNEL TAKEN NOVEMBER 20, 1902, FROM NORTH PUMP WELL
AT STATION 12 + 20 AND FROM A PERCOLATION THROUGH CON-
CRETE AT STATION 9 + 00.

Expressed in parts per million.

	Pump Well.	Water through Concrete, Sta. 9 + 00.
Total residue on evaporation	2,763.2	20,744.0
Organic and volatile matter	392.0	922.6
Fixed mineral matter	2,371.2	19,821.4
Chlorine	1,283.4	10,212.5
Sulphuric Acid (H_2SO_4)	140.8	568.8

From the above analysis sample from " Pump well " appears to contain about one-sixteenth sea water and sample of " Water through concrete, Sta. 9," about one-half sea water. The mineral matter in the latter sample is probably greatly concentrated in consequence of evaporation, as the percolation through the concrete was very slow.

APPENDIX I.

ANALYSIS BY PROFESSOR CARMICHAEL JUNE 30, 1903, OF SAMPLE OF
WATER TAKEN FROM ARCH AT STATION 39+42.50 OF SECTION B
OF THE EAST BOSTON TUNNEL.

Expressed in parts per million.

Total residue on evaporation	. . . . .	11,501
Organic and volatile matter	. . . . .	2,270
Fixed mineral matter	. . . . .	9,231
Chlorine	. . . . .	4,728
Sulphuric acid (H_2SO_4)	. . . . .	733

From the above analysis the sample appears to contain about one-fifth sea water.

NOTE. — The water was taken from a small iron pipe which entered the concrete arch to a depth of about four inches, where a small leak occurred at a point under the harbor.

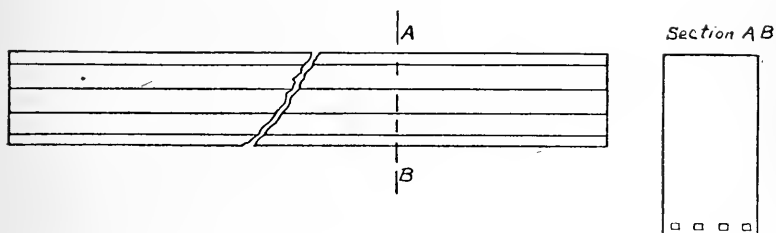
APPENDIX J.

COMPARISON OF TRANSVERSE STRENGTH OF CONCRETE BEAMS, 6 IN.
X 6 IN. X 30 IN. (BREAKING LENGTH) TWO BURIED IN SAND
UNDER SEA WATER AND ONE BURIED IN FRESH EARTH.

BRAND.	Proportions by Volume.			Time buried in Sand under Sea Water.	Time buried in Fresh Earth.	Modulus of Rup- ture in pounds, per square inch.
	Parts Cement.	Parts Sand.	Parts Crushed Stone.			
Alpha	1	2½	4	3 yrs.	.....	726
Alpha	1	2½	4	3 yrs.	.....	972
Alpha	1	2½	4	.....	3 yrs.	809

Experiments have been made with concrete briquettes (Vulcanite cement) exposed in salt water and also with briquettes kept in fresh water, both of which waters were changed daily. The concrete acquired nearly its full strength in 4 months, got a little stronger for the next 2 or 3 months, and then fell off slightly later on. Some other high grades of Portland cement concrete similarly treated acquired about the same strength at the end of 2 years, but were not nearly so strong at any prior time.

APPENDIX K.



TRANSVERSE STRENGTH OF REINFORCED CONCRETE BEAMS.

Designating Number of Beams.	Age of Beams when Broken.	Equivalent Centre Load Required to Break Beams, Pounds.	Kind of Rods Used. Johnson Bars furnished By St. Louis Ex- panded Metal Fireproofing Co.
5	2½ months	62,500	¾" square corrugated, 1.45 lbs. per ft.
6	3 "	58,000	" " " " " "

Cement used, Vulcanite Portland.

Proportions, 1 bbl. of cement, 9 cu. ft. of stone dust, and 11 cu. ft. of crushed stone.

Size of beams, 21' x 2' x 1'.

Distance between points of support, 20 feet.

Load applied at centre of beam.

NOTE. — In beam number 5 the rods were coated with paint made of linseed oil and Portland cement.

In beam number 6 the rods were fresh from sand blast.

Beam number 5 was made on Oct. 3, 1902, and number 6 on Oct. 7, 1902. They were placed in a trench 30 inches deep and covered with fresh earth.

Number 5 was broken on Dec. 20, 1902, and number 6 was broken on Jan. 7, 1903.

APPENDIX L.

EFFECT OF VIBRATIONS ON FRESH CONCRETE.

Fifteen concrete beams, $6'' \times 6'' \times 30''$ (breaking length), were made which were divided into lots of 3 beams each, and at the end of 30 days each beam was broken transversely by centre loading.

The beams were made March 4, 1903, and broken April 1, 1903.

The concrete was machine mixed, and made according to the following proportion:

1 bbl. cement (Portland).
4 cu. ft. sand (coarse).
4 cu. ft. stone dust (fine).
12 cu. ft. broken stone.

The beams were kept in wooden boxes during the whole time, but there was a clear space of about $\frac{1}{4}$ inch between the top of the concrete beam and the plank which formed the top of the mould.

The following table shows the breaking strength of the beams:

Weight of Beam.	Breaking Weight, Pounds.	Modulus of Rupture.	Average Modulus of Rupture.	Time from when the beams were made till they were sub- jected to vibrations.	REMARKS.
120	3,500	719.4	794.9	Kept in free air where they were free from vibrations. Exposed to a temperature of about 40° F.
120	4,000	823.3			
119	4,090	842.2			
118.5	4,500	927.6	899.2	3 hrs.	Placed on a platform, in shaft of Section C, E. B. T., which received considerable vibration caused by the working of concrete mixer and engine. Temperature was about 40° F.
115.5	4,250	875.8			
119.5	4,340	894.2			
118	4,170	858.9	745.1	3 hrs.	Placed on a platform suspended to a timber crossing State street, and received vibrations from teams and electric cars passing directly over it. Temperature varied from 32° to 50° F.
117.5	3,350	688.1			
114.5	3,330	688.4			
116	4,180	861.2	859.8	3 hrs.	Buried under ties of Boston Elevated Railroad track in subway incline, so that beam laid parallel with the rail and hard against the under side of end of the ties. Temperature varied from 32° to 50° F.
118	4,250	875.6			
115	4,090	842.5			
118	3,680	756.8	808.9	3 hrs.	Placed along side ends of ties on trestle of Boston Elevated Railroad at the curve near train shed, Sullivansquare, and received considerable jarring every time a train passed. Temperature was not determined.
120	4,020	827.5			
115.5	4,090	842.5			

APPENDIX M.

SHRINKAGE OF CLAY.

Experiment No. 1.

Clay containing apparently no sand, and taken from Section B, East Boston Tunnel.

	No. 1.	No. 2.	No. 3.
Shrinkage in volume	19.5%	19.3%	16.3%
“ “ weight	21.4%	22.2%	21.4%
1 cubic foot of clay as taken from tunnel became, when dry, .8 cubic ft.			
1 linear foot “ “ “ “ “ “ “ “ “ “ “ “ .93 ft.			
A shrinkage of 7% in weight corresponds to shrinkage of 12.7% in volume.			
“ “ “ 21.5% “ “ “ “ “ “ “ 16.6% “ “			

Experiment No. 2.

Clay containing 30% of fine sand, and taken from Section C, East Boston Tunnel.

Shrinkage in volume	11.5%
“ “ weight	18.6%
1 cubic foot of clay as taken from tunnel became, when dry, .9 cubic ft.	
1 linear “ “ “ “ “ “ “ “ “ “ “ “ .96 ft.	

Experiment No. 3.

Clay taken from Section B, about 6 feet below top edge of shield.

Shrinkage in volume	22.5%
1 cubic foot of clay as taken from tunnel became, when dry, .8 cubic ft.	

This sample of clay contained a very small amount of fine sand.

NOTE. — In the above experiments the clay experimented on was as nearly as possible just as taken from the tunnel. The shrinkage was determined after the clay had been dried beside a warm stove for three days.

APPENDIX N.

CANVASS OF BIDS FOR CONSTRUCTION OF SIDE WALLS AND SEWER, PART OF SECTION D, EAST BOSTON TUNNEL, JULY 31, 1902.

BIDDERS AND ADDRESSES.	a	b	d	e	f	g	h	i	x	Totals.	Time of Beginning.	Time of Completing.
	12,000 Cu. Yds. Earth Ex- cavation Including Back- filling and Disposal of Surplus.	8,500 Cu. Yds. Concrete Port. Cem. Mortar.	Abt. 80 Tons Steel Rods, etc. Set in Place and Secured.	Laying 560 Lin. Ft. 20-in. Vitrified Pipe.	Laying 60 Lin. Ft. 15-in. Vitrified Pipe.	1,500 Sq. Yds. Coating Portland Cement Mortar.	1,500 Sq. Yds. Tarred Felt, Pitch, etc.	Putting in Place and Tamping abt. 500 Cu. Yds. Clay Boxing.	Percentage on \$1,500 Worth of Extra Work.			
Jones & Meehan, } Boston }	\$7 00 84,000	\$14 50 50,750	\$25 00 750	\$1 50 840	\$1 50 90 00	\$1 00 1,500	\$0 50 750	\$5 00 2,500	25% \$375	\$141,555	Aug. 11, 1902	April 11, 1903
Metropolitan Cont. } Co. Boston }	7 15 85,800	11 40 39,900	18 00 540	3 50 1,960	3 00 180	1 10 1,650	0 25 375	1 85 925	15% \$225	131,555	" 9, "	Dec. 31, 1902
P. McGovern, } Roxbury }	6 40 76,800	12 00 42,000	100 00 3,000	2 50 1,400	2 25 135	0 75 1,125	0 75 1,125	1 00 500	15% \$225	126,310	" 11, "	Feb. 11, 1903

APPENDIX O.

CANVASS OF BIDS FOR 115 TONS OF STEEL, PART OF SECTION E,
EAST BOSTON TUNNEL. BIDS OPENED SEPT. 2, 1902.

BIDDER.	Price per Ton.	Amount.
H. P. Converse & Co., 8 Oliver street, Boston.....	\$141 00	\$16,215 00
New England Structural Co., 18 Post Office square, Boston.....	138 45	15,921 75
Eastern Bridge & Structural Co., 112 Water street, Boston.....	135 00	15,525 00

APPENDIX P.

CANVASS OF BIDS FOR PORTIONS OF SIDE WALLS, ETC., OUTSIDE OF THE OLD STATE HOUSE, PART OF SECTION E, EAST BOSTON TUNNEL, SEPT. 4, 1902.

BIDDERS AND ADDRESSES.	Totals.										
	a	b	c	d	e	f	g	h	i	x	
	2,400 Cu. Yds. Earth Excavation, including Backfilling and Dis- posal of Surplus.	500 Cu. Yds. Concrete Port. Cem. Mortar.	Abt. 6 Tons Steel Rods, etc., set in Place and Secured.	Laying abt. 120 Lin. Ft. 15-in. Vitrified Pipe.	Laying abt. 100 Lin. Ft. 12-in. Vitrified Pipe.	Laying Abt. 30 Cu. Yds. Brick Masonry, Port. Cem. Mortar, holes, etc.	500 Sq. Yds. Coating Portland Cement Mortar.	500 Sq. Yds. Water- proof Coating of Pitch.	700 Sq. Yds. Tarred or more Layers.	Putting in Place and Tamping, abt. 600 Cu. Yds. Clay Boxing.	Percentage on \$1,500 Worth of Extra Work.
Lawler Bros., Charlestown	\$11 00 26,400	\$14 00 7,000	\$50 00 300	\$2 00 240	\$2 00 200	\$80 00 2,400	\$1 15 575	\$0 50 250	\$ 60 420	\$1 50 750	20 \$300
Jones & Meehan, Boston	7 00 16,800	14 50 7,950	25 00 150	2 00 240	2 00 200	30 00 900	1 00 500	1 00 500	0 50 350	5 00 2,500	25% \$375
Chas. King & Co., Boston	7 00 16,800	12 00 6,000	35 00 210	3 00 360	3 00 300	25 00 750	1 00 500	1 00 500	0 25 175	2 00 1,000	15% \$225
Shailer & Dunfee, Boston	6 25 15,000	14 00 7,000	25 00 150	2 00 240	1 75 175	28 00 840	0 75 375	0 25 125	0 20 140	4 00 2,000	25% \$375
Patrick McGovern, Roxbury	6 75 16,200	11 00 5,500	50 00 300	2 25 270	2 00 200	30 00 900	0 75 375	0 45 225	0 22 154	2 00 1,000	15% \$225
Met. Contracting Co., Boston	6 06 14,544	11 40 5,700	18 00 108	3 50 420	3 00 300	30 00 900	0 50 250	0 25 125	0 30 210	1 40 700	20% \$300
E. W. Everson & Co., Providence	5 50 13,200	10 00 5,000	50 00 300	1 00 120	1 00 100	20 00 600	1 00 500	1 00 500	0 50 350	1 50 750	50% \$750
Gow & Foss, Boston	5 25 12,600	11 00 5,500	20 00 120	0 50 60	0 50 50	18 00 540	0 50 250	0 50 250	0 20 140	3 00 1,500	15% \$225

APPENDIX Q.

BIDS FOR 20 TO 30 BORINGS FOR NEW TUNNEL, OCT. 23, 1902.

BIDDER.	Price per Foot.
B. F. Smith & Brother.....	58c.
Edward A. Clark	55c.
Gow & Foss	50c.
Patrick J. Healey.....	50c.

APPENDIX R.

CANVASS OF BIDS FOR FURNISHING STEEL FOR ALTERATIONS IN EAST
END OF OLD STATE HOUSE, SECTION E OF THE EAST BOSTON
TUNNEL. BIDS OPENED NOV. 6, 1902.

BIDDERS AND ADDRESSES.	About 25 Tons.	
	Price per Ton.	Totals.
Boston Steel & Iron Co., 166 Devonshire street, Boston.....	\$115 20	\$2,880 00
American Bridge Co., 89 State street, Boston.....	111 90	2,797 50
H. P. Converse & Co., 8 Oliver street, Boston.....	99 50	2,487 50
New England Structural Co., 18 Post Office square, Boston.....	98 00	2,450 00
Berlin Construction Co., 131 State street, Boston.....	90 00	2,250 00
Eastern Bridge & Structural Co., Station A, Worcester, Mass.	90 00	2,250 00
Belmont Iron Works, 22d street and Washington avenue, Philadelphia, Penn.	73 45	1,836 25
G. W. & F. Smith Iron Co., Gerard street, Roxbury, Mass.	69 00	1,725 00

APPENDIX S.

CANVASS OF BIDS FOR BUILDING FOUNDATIONS FOR COLUMNS, ERECTING COLUMNS, AND CONSTRUCTING ROOF OF PART OF THE OLD STATE HOUSE STATION, PART OF SECTION E, EAST BOSTON TUNNEL, NOV. 26, 1902.

BIDDERS AND ADDRESSES.	a	aa	3a	b	d	g	gg	h	Totals.
	3,600 Cu. Yds. Earth Excavation.	15 Cu. Yds. Bank Gravel between Concrete Column Footings, etc.	Relaying 1,000 Sq. Yds. of Block Pav- ing on Gravel Base.	800 Cu. Yds. Portland Cement Concrete.	Errecting 115 Tons of Steel Girders, etc.	1,100 Sq. Yds. of Port- land Cement Mor- tar.	1,100 Sq. Yds. of Pitch or Asphalt.	2,300 Sq. Yds. of Tarred Felt, etc.	
Jones and Meehan, Boston. }	\$7 00 25,200 00	\$2 00 30 00	\$1 50 1,500 00	\$15 50 12,400 00	\$30 00 3,450 00	\$0 50 550 00	\$0 50 550 00	\$0 30 690 00	\$44,370
Shailer & Dunfee Co., Boston. ... }	6 75 24,300 00	3 00 45 00	1 00 1,000 00	15 00 12,000 00	22 00 2,530 00	0 75 825 00	0 50 550 00	0 30 690 00	41,940
Metropolitan Contracting Co., Boston. }	6 75 24,300 00	2 00 30 00	1 00 1,000 00	13 10 10,480 00	23 00 2,645 00	1 00 1,100 00	0 50 550 00	0 30 690 00	40,795
Patrick McGovern, 57 Maywood street, Roxbury. }	5 75 20,700 00	2 00 30 00	0 80 800 00	13 50 10,800 00	30 00 3,450 00	0 75 825 00	0 50 550 00	0 25 575 00	37,730
H. P. Nawn, Savin street, Rox- bury. }	6 50 23,400 00	2 00 30 00	0 75 750 00	11 50 9,200 00	15 00 1,725 00	0 60 660 00	0 50 550 00	0 30 690 00	37,005

APPENDIX T.

CANVASS OF BIDS FOR CONSTRUCTING TUNNEL AT THE HEAD OF STATE STREET AND MAKING ALTERATIONS AND ADDITIONS TO THE OLD STATE HOUSE, PART OF SECTION E, EAST BOSTON TUNNEL, JAN. 1, 1903.

BIDDERS AND ADDRESSES.	a	b	c	d	e	f	g	h	i	j	k	l	m	n	Totals.	Time of Completion.
	5,500 Cu. Yds. Earth Excavation.	Removing and Disposing of 75 Cu. Yds. Old Masonry.	15 Cu. Yds. Cut Granite Masonry.	Building Smoke Flue.	1,330 Cu. Yds. Portland Cement Concrete.	Relaying 125 Cu. Yds. of Old Foundation Walls.	Setting and Securing 30 Tons Steel and Iron.	Furnishing and Applying 630 Sq. Yds. Portland Cement Mortar.	Preparing and Applying 630 Sq. Yds. Pitch or Asphalt.	Preparing and Applying Tarred Felt.	Relaying 100 Sq. Yds. Block Paving.	Furnishing and Laying 200 Lin. Feet New Granite Curb.	Furnishing and Putting in Place 525 Sq. Yds. of Granolithic.	Supporting Old State House, etc., etc.	Totals.	Time of Completion.
J. Cavanagh & Son, B. M. Co., Boston.	\$9,335 51,315	\$5,000 375	\$22,000 480	\$1,200 1,200	\$20,000 26,600	\$15,000 1,875	\$30,000 900	\$1,000 630	\$0.50 315	\$0.20 126	\$1.00 100	\$3.00 600	\$2.00 1,050	\$17,900 17,900	103,466	Oct. 1, 1903.
McGawley & Coughlin, Boston . . .	7.25 39,875	7.25 543.75	55.00 825	500 500	14,000 18,620	8.00 1,600	50.00 1,500	1.00 630	0.50 315	0.50 315	0.90 90.00	1.10 220	1.25 656.25	18,000 18,000	83,090	May 1, 1903.
H. P. Nawn, Savin Street, Roxbury.	6.00 33,000	3.00 225	60.00 900	500 500	11.00 14,630	6.00 750	15.00 450	1.00 630	0.30 189	0.60 378	1.00 100	1.00 200	0.90 472.50	12,700 12,700	65,124.50	May 20, 1903.
John Y. Mainland, Boston	3.60 19,800	8.20 615	72.00 1,080	320 320	13.90 18,487	5.40 675	21.00 630	0.84 529.20	0.40 252	0.60 378	1.87 187	1.40 280	1.92 1,008	13,848 13,848	58,089.20	July 6, 1903.
Metropolitan Cont'g Co., Boston . .	4.50 24,750	5.00 375	50.00 750	300 300	11.25 14,962.50	6.00 750	30.00 900	0.72 453.60	0.50 315	0.25 157.50	1.00 100	1.00 200	1.00 525	8,500 8,500	53,038.60	June 1, 1903.
Jones & Meehan, Boston	5.00 27,500	10.00 750	40.00 600	200 200	12.00 15,960	. . . . .	20.00 600	0.80 504	0.50 315	0.30 189	1.50 150	1.10 220	2.00 1,050	5,000 5,000	53,038	May 1, 1903.
Patrick McGovern, Roxbury	4.00 22,000	5.00 375	40.00 600	300 300	11.50 15,295	5.00 625	20.00 600	0.50 315	0.50 315	0.20 126	0.50 50	1.00 200	1.00 525	3,845 3,845	45,171	May 20, 1903.
E. W. Everson & Co., Rox. Cross'gs.	3.00 16,500	5.00 375	60.00 900	250 250	12.50 16,625	8.00 1,000	30.00 900	0.50 315	0.50 315	0.25 157.50	1.00 100	1.00 200	2.00 1,050	4,000 4,000	42,687.50	May 15, 1903.
Woodbury & Leigh-ton, Boston . . .	2.00 11,000	2.50 187.50	75.00 1,125	1,000 1,000	7.50 9,975	6.75 843.75	10.00 300	0.75 472.50	0.35 220.30	0.50 315	1.00 100	1.25 250	1.312.50 1,312.50	12,000 12,000	39,101.75	July 1, 1903.

APPENDIX U.

CANVASS OF BIDS FOR COMPLETING THE CONSTRUCTION OF SECTION C, EAST BOSTON TUNNEL, JAN. 20, 1903.

BIDDERS AND ADDRESSES.	a.	2a.	d.	2d.	f.	2ff.	3ff.	g.	h.	2h.	3h.	4h.	r.	t.	tt.	Supporting and Protecting Buildings, etc., if Items (2a) and (3ff) are Included.	2u.	Totals, Including Items 2a, 3ff.	Totals, Omitting Items, 2a 3ff.	Time of Completion if Items 2a and 3ff are Included.	Time of Completion if Items 2a and 3ff are Omitted.
	6,000 Cu. Yds. Earth Excavation West of 53 + 67.5.	7,000 Cu. Yds. Excavation in part of Passenger Station.	40 Tons Cast Iron Push Rods and other Iron and Steel except Item (2d) Setting and Securing.	100 Tons Iron and Steel Tie-rods and Apparatuses, Setting and Securing.	500 Cu. Yds. Portland Concrete, with Interior Skin of Mortar, West of Station 53 + 67.5.	2,000 Cu. Yds. Portland Concrete, without Interior Skin of Mortar, West of Station 53 + 67.5.	3,000 Cu. Yds. Portland Concrete, in Part of Passenger Station.	Removing Brick Bulbheads around Air-lock and delivering said Locks on Surface.	4,000 Sq. Yds. Coating of Portland Cement Mortar.	200 Cu. Yds. Grout, 1 part Cement, 1 part Sand.	200 Barrels Portland Cement.	200 Cu. Yds. Fine Sand.	50 Sq. Yds. Clay Boxing.	100 Sq. Yds. Water-proof Coating (Pitch).	700 Sq. Yds. Tarred Felt, Pitch, etc.	Supporting and Protecting Buildings, etc., if Items (2a) and (3ff) are Included.	Supporting and Protecting Buildings, etc., if Items (2a) and (3ff) are Omitted.			Time of Completion if Items 2a and 3ff are Included.	Time of Completion if Items 2a and 3ff are Omitted.
H. P. Nawn, Roxbury. . .	\$9,300 54,000	\$9,000 63,000	\$20,000 800	\$10,000 1,000	\$13,000 9,000	\$17,000 34,000	\$17,000 51,000	\$1,500 1,500	\$0.50 2,000	\$10.00 2,000	\$3.00 600	\$0.50 100	\$1.0 50	\$0.50 50	\$1.00 700	\$60,000 60,000	\$60,000 60,000	\$279,500	\$165,800	Jan. 1, 1904.	Nov. 15, 1903.
McGawley & Coughlin, Boston.	6,000 36,000	8,000 56,000	30,000 1,200	20,000 2,000	17,000 8,500	17,000 34,000	17,000 51,000	1,000 1,000	0.50 2,400	18.00 3,600	3.00 600	2.00 400	2.00 10	0.75 75	0.90 630	73,000 73,000	50,000 50,000	270,505	140,505	Jan. 1, 1904.	May 1, 1903.
Metropolitan Cont'g Co., Boston.	6,088 36,480	11,500 80,500	6,000 240	15,000 1,500	18,000 9,000	15,500 31,000	16,000 48,000	1,150 1,150	0.70 1,150	20.00 4,000	2.15 430	1.84 368	0.50 25	0.50 50	0.30 210	40,000 40,000	8,000 8,000	255,753	95,253	Jan. 1, 1904.	June 1, 1903.
Jones & Meahan, Boston.	6,000 36,000	20,000 63,000	20,000 800	20,000 2,000	18,000 8,000	12,000 24,000	20,000 60,000	2,000 2,000	0.75 3,000	25.00 5,000	2.50 500	2.00 400	1.00 50	0.60 60	0.40 280	46,000 46,000	20,000 20,000	251,000	102,000	Feb. 1, 1904.	Aug. 1, 1903.
P. McGovern, Roxbury.	6,500 39,000	9,250 64,750	3,000 120	3,000 300	16,000 8,000	15,000 30,000	17,500 52,500	1,250 1,250	0.75 3,000	20.00 4,000	2.00 400	2.00 400	1.00 50	0.50 50	0.25 175	32,000 32,000	7,000 7,000	235,995	93,745	Nov. 15, 1903.	Mar. 31, 1903.

APPENDIX V.

BIDS FOR FURNISHING MARBLE FINISH, OLD STATE HOUSE STATION,
SECTION E, FEB. 12, 1903.

BIDDERS AND ADDRESSES.	Amount of Bid.
Bowker, Torrey & Co., 118 Portland street, Boston.	\$1,297
Vermont Marble Co., 8 Thacher street, Boston.....	710
Norcross Brothers Co., { Italian.....	517*
Tremont Building, Boston { Vermont.....	477

* Accepted.

APPENDIX W.

BIDS FOR CROSS-WALK OF ARTIFICIAL STONE OVER THE EAST BOSTON TUNNEL IN MAVERICK SQUARE, EAST BOSTON, INCLUDING GRANITE CURB EACH SIDE, WROUGHT-IRON PIPE FENCE, ETC.

BIDDER.	Price Bid.	Time of Commencing Work.	Time of Completing Work.
		1903.	1903.
Edgar R. Taylor & Co.....	\$1,306	May 4	June 4
W. A. Murtfeldt Co.....	1,041	" 5	" 5
Thomas J. Hind.....	1,033	" 6	" 1
Simpson Bros. Corporation....	998	" 4	" 8

APPENDIX X.

CANVASS OF BIDS FOR STEEL POSTS, I-BEAMS, AND ONE GIRDER
FOR SECTION F. BIDS OPENED JUNE 30, 1903.

BIDDERS AND ADDRESSES.	About 115 Tons.	
	Price per Ton.	Totals.
Eastern Bridge and Structural Co., Worcester, Mass.....	\$90 00	\$10,350 00
Alpheus B. Robbins, 161 Albany street, Boston.....	85 00	9,775 00
Belmont Iron Works, Philadelphia, Pa.....	84 94	9,768 10
G. W. & F. Smith Iron Co., Gerard street, Roxbury, Mass.....	75 00	8,625 00
New England Structural Co., 110 State street, Boston, Mass.....	68 70	7,900 50

APPENDIX Y.

EAST BOSTON TUNNEL.

ELECTRIC CONDUITS RELOCATED DURING YEAR ENDING JUNE 30, 1903.

COMPANY.	REMOVED.				RELAID.				REMARKS.
	Linear feet.	Duct feet.	Manholes.	House Services.		Linear feet.	Duct feet.	Manholes.	
				No.	Length.				
Boston Elev. Ry. Co.	103	1,648	1			463	4,201	7	Duct laid inside tunnel.
" " "	112	1,344	1			110	1,983	3	Permanent clay ducts.
Edison Elec. Ill. Co.	809	5,779	10	6	247	112	1,344	1	Temporary iron pipes.
" " "	107	701				762	9,329	12	Permanent clay ducts.
" " "	3,300	3,300	1	18	247	108	701		Temporary iron pipes.
" " "	683	683				3,286	3,286	1	Permanent tubes, solid system.
Low Tension Wire Assn.	424	1,911	3	5	125	571	571	18	Temporary " "
" " "	568	5,457	6	5	256	606	3,244	7	Laid on permit from Wire Dept.
Mass. Tel. & Tel. Co.	732	8,534	8	13	525	571	1,825	2	Laid on permit from Wire Dept.
" " "	151	1,362	2			542	5,663	6	Laid on permit from Wire Dept.
New England Tel. & Tel. Co.	444	887	4				16,864	13	Laid on permit from Wire Dept.
" " "	697	2,985	5	2	40	151	908	2	Steam-heating conduits.
Postal Tel. Cable Co.									
" " "						682	3,028	8	Laid on permit from Wire Dept.
" " "						223	447	1	Laid on permit from Wire Dept.
Police Signal Service				1	8				
" " "				9	307				
Western Union Tel. Co.	643	6,044	7			954	9,348	9	Laid on permit from Wire Dept.
" " "						78	1,248		Laid on permit from Wire Dept.
Total.....	8,773	40,635	48	59	1,755	10,062	63,990	72	73 2,632

APPENDIX Z.

EAST BOSTON TUNNEL.

WATER MAINS RELOCATED BY THE BOSTON TRANSIT COMMISSION
DURING THE YEAR ENDING JUNE 30, 1903.

Size.	Linear Feet Removed.	Hydrants Removed.	Gates Removed.	Linear Feet Relaid.	Hydrants Reset.	Gates Reset.
6-inch	63	.....	1	31		
8 "	867	.....	3	103 Temporary, 200	.....	2 Temporary, 1
10 "	.....	.....	.....	51	.....	1
12 "	114	.....	1	1,059	1	3
16 "	519	3	1	526	3	1
24 "	33	.....	1	33	.....	1
Total ..	1,596	3	7	2,003	4	9

New fire-pipes to buildings	.	.	.	.	.	3
Services reconnected to mains	.	.	.	.	.	9
New services	.	.	.	.	.	3
Total services relocated	.	.	.	.	.	12
New services inside buildings	.	.	.	.	.	3

APPENDIX 2 Z.

EAST BOSTON TUNNEL.

SEWERS RELOCATED DURING YEAR ENDED JULY 1, 1903.

REMOVED.		RELAID.	
Size.	Linear Feet.	Size.	Linear Feet.
3 feet \times 3 feet, wooden ..	340	2'-2" \times 3'-3" concrete ..	902
2'-2" \times 2'-3" brick.....	283	Do. additional at Congress st.	48
20" barrel	40	20" pipe.....	717
1'-9" \times 1-6"	95	15".....	266.5
		12".....	126
		12" temporary.....	90
Total.....	758	Total.....	2,149

Manholes removed 4
Catch-basins " 6

House connections relocated . 30
Manholes built 11
Catch-basins relocated 4

APPENDIX 3 Z.

EAST BOSTON TUNNEL.

GAS MAINS RELOCATED BY THE BOSTON GAS LIGHT COMPANY
DURING THE YEAR ENDING JUNE 30, 1903.

Size.	Linear Feet Removed.	Gates Removed.	Linear Feet Relaid.	Gates Set.
24-inch ...	.....	.....	49	
18 " ...	136	.....	.....	1
12 " ...	266	2	1,052	5
6 " ...	1,691	12	870	7
4 " ...	198	2	330	1
3 " ...	165			
1½ " ...	.....	.....	Temporary, 405	
Total	2,456	16	2,706	14

11 house services relaid.

NOTE.—The above table does not include a considerable length of abandoned gas-pipe removed of which no record was made.

APPENDIX 4 Z.

EAST BOSTON TUNNEL.

SUMMARY OF STRUCTURES RELOCATED PRINCIPALLY ON STATE STREET,
DURING YEAR ENDING JUNE 30, 1903.

	REMOVED.			RELAID.		
	Linear Feet.	Man-holes.	Services.	Linear Feet.	Man-holes.	Services.
Conduits for electric wires ...	8,773	48	59	10,062	72	73
Water-pipes	1,596	.....	12	2,003	1	12
Sewers	758	10	3	2,149	15	30
Gas-pipes	2,456	.....	11	2,706	.....	11
Total	13,583	58	112	16,920	88	126

NOTE. — All of the above with the exception of about 600 feet of gas-pipe were relocated in State street, between the Custom House and Washington street, a length of about 900 feet.



